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ABSTRACT

A 2-year longitudinal/cross-sectional project investigated factors related to highly able Mexican Americans' decisions to avoid or take advanced mathematics. Questionnaires were given to roughly 350 Mexican Americans and to an equal number of equally able Anglo-Americans. Subjects were distributed evenly across grades 9, 10, and 11. Results indicated achievement is most strongly affected by overall attitudes towards mathematics, secondly by cognitive style, and lastly by educational expectations. Sex difference in achievement found in earlier studies was not supported, with ethnicity also having no apparent effect on mathematics achievement. Educational expectations and overall attitudes towards mathematics were found to be the best predictors of mathematical persistence, and cognitive style had no effect on this. It is further noted that as students progress through the grades, girls appear to lower their expectations while boys raise theirs. Finally, analysis indicates the two categories that most strongly affect persistence are affected by various intervening variables. The document concludes with suggestions for intervention strategies for increasing mathematics participation of all highly able students. (MP)

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FACTORS INFLUENCING MATHEMATICS PARTICIPATION OF HIGHLY ABLE MEXICAN-AMERICAN ADOLESCENTS

Final Report to the National Science Foundation
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ABSTRACT

A two year longitudinal/cross-sectional project investigated the factors related to highly able Mexican Americans' decisions to avoid or persist in advanced math courses and examined the relative importance of those factors as well as their stability over time. Questionnaires were administered to approximately 350 highly able Mexican American students and an equal number of highly able Anglos distributed evenly among grades 9, 10, and 11. The data collection centered upon educational and occupational aspirations, overall attitudes toward school, participation in mathematics, parental influences, various self-descriptors and the influence of significant others in the students' lives. Additionally, in-depth interviews were conducted with the father, mother, and respondents of twenty-five sample cases. Correlations, anovas and path analysis were performed on the survey data to identify those factors which most affect persistence and achievement in mathematics.

The results of the study indicate that achievement is most strongly effected by overall attitudes toward mathematics, secondly by cognitive style (GEFT) and lastly by educational expectations. Although sex had a small causal effect on both overall attitudes toward mathematics and educational expectations, the sex

differences in achievement found in earlier studies was not supported here. The achievement data indicates that ethnicity has no effect on student achievement.

Student's educational expectations and overall attitudes toward mathematics are the best predictors of math persistence. Cognitive style has no effect on this variable. The results indicate that as students progress through the grades the more courses they plan to take. Sex differences in planned courses favor the males. Given the same ability as boys, girls tend to take fewer advanced math courses. Girls begin high school with the same overall attitude toward math as boys but with a higher level of educational expectation. As they progress through the grades however, girls lower their level of expectation while boys raise theirs. Further, boys develop a more positive attitude toward mathematics but the reverse is true for girls. Of significance is the fact that controlling for other variables in the path model, ethnicity has no effect on mathematics persistences of highly able adolescents.

The results indicate that the two categories that most strongly effect persistence are affected by various intervenable variables. Overall attitudes toward mathematics is most strongly affected by teachers' influence followed closely by parents as educational role models, parents educational expectations, and

respondents' educational expectations. Educational expectations are most strongly influenced by occupational expectations and parents' educational expectations followed closely by parents as role models and teacher influence.

At the conclusion of this report, implied intervention strategies are suggested which may increase mathematics participation of highly able adolescents regardless of sex or ethnicity.

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CHAPTER I

Introduction

A review of the literature supports the current belief that underrepresentation of Mexican American students in mathematics-related majors is indeed a problem of national concern. Educational Research in America, 1975, indicated that although in 1974 approximately 5.2% of the U.S. population was Mexican American, less than .6% of the total doctorates awarded in the mathematical sciences went to this ethnic group.

The Office of Communication Services, National Association of State Universities and Land Grant Colleges, reported in April 1979 that of the undergraduates enrolled during the Fall of 1978 only 2.2% were Hispanic. Further, only 1.5% of the graduate student population was Hispanic. Another publication (Glover, 1979) reported that minorities are grossly underrepresented in the field of engineering. In 1974, Spanish surnamed students made up 1.5% of the engineering graduates but 5.2% of the general population.

The student population at Arizona State University during the Fall 1979 semester numbered 37,755. Of this enrollment only 4.2% was Hispanic while Hispanics comprise 18.7% of the total population in the State of Arizona.

Arizona State University is not unique in its lack of math-science Mexican American students. Preparation for professional careers in mathematics and the physical sciences is, on the whole, open only to those college students who pursued the sustained study of these subjects in secondary school. Lack of advanced high school mathematics preparation constrains many future educational and occupational choices. It is, therefore, the intent of this study to investigate the cognitive, affective, educational, and social determinants of one's decision to take or not to take mathematics courses, to trace the development of the decision to avoid or participate, and to test the stability of the significance of the influencing factors over time. Results from the study will include suggestions for future interventions that will divert a greater portion of this minority group into the creation and dissemination of scientific knowledge.

The survey approach is particularly appropriate for a baseline study in an area as complex as Mexican American persistence in advanced mathematics where the diversity of factors and their relationships may suggest many possible explanations. Previous studies dealing with women and mathematics show a lack of agreement regarding the significance of suggested variables on participation.

Studies pertaining to the other minorities looked at only a few variables at a time and most sample sizes were small resulting in a lack of statistical power. A large scale survey such as that used in this study (700 students) is one way to avoid problems produced by earlier limited samples. Thus, a major significance of this study will be in determining the degree to which each of the possible variables effect Mexican American students' decisions to pursue advanced mathematics courses in high school.

CHAPTER II

Review of Related Research

This review of the literature will begin with a discussion of the variables which appear to separate Hispanic students most consistently from their Anglo counterparts: cognitive style, language environment, acculturation, alienation, value orientation and locus of control. No studies were found which have suggested any reasons for Hispanics' apparent tendencies to avoid the pursuit of mathematics. Armstrong (1980) had hoped to do this but lacked adequate representation of this minority group in her study. Lack of pertinent work in this area necessitates searching into related literature pertaining to other minorities and mathematics--specifically women and blacks. Finally a brief review of career choice-decision making techniques and information will be presented.

Cognitive Style

It is only recently that educational research has looked at differential patterns of intellectual style among ethnic groups (Lesser, et al., 1965). The insight that there exists, within ethnic groups, culturally unique learning styles opened the door for Ramirez and Castaneda to explore specific cognitive styles within Mexican American children (1974). The literature consistently indicates that "members of groups which emphasize respect

for family and religious authority and group identity, and which are characterized by shared-function family and friendship groups, tend to be field dependent in cognitive style". (Ramirez and Price-Williams, 1974, p. 217). Mexican American children, in addition to having characteristic Incentive-Motivational and Human Potential Styles were found to be more field dependent than other children. (Ramirez, 1973).

Witkin distinguishes the two cognitive styles in the following manner:

> "In a field dependent mode of perception, the organization of the field as a whole dominates perception of its parts: an item within a field is experienced as fused with organized ground. In a field-independent mode of perception, the person is able to perceive items as discrete from the organized field in which they are part." (Witkin, 1967).

In an ethnographic study Kersher observed that Chicano children as opposed to Anglo children "showed less interest in the details and organization of their spacial surroundings...". Thus, Kersher interpreted that the information processing strategy of Anglos fitted the "analytic spacial" categorization as opposed to the "global-verbal" of Chicanos (1972).

In a study of Affective and Associative Qualities in the learning style of Chicanos and Anglos, Garza found that Chicanos "differed from Anglos in affective learning style, manifesting a greater propensity to learn their liked materials more readily than their disliked materials" (1978). It should be noted, however, that while various studies using single method approaches indicated that cognitive style of field dependency is associated with Mexican American children (Buriel, 1975; Kagen and Zahn, 1975; Ramirez and Price-Williams, 1974; Sanders, Scholz, and S. Kagen, 1976), Buriel (1978), using multiple measures of field dependence indicated contradictory evidence. Specifically the "results generally failed to support the assumptions that:(a) Mexican American children are more field dependent than Anglo children, (b) intercorrelation between the three field dependence tests is significant and comparable for members of both cultural groups, and (c) field dependence is of substantial importance to the school achievement of Anglo American and Mexican American children." Buriel further warned that researchers should be aware that results obtained from a single measure of field dependence may be more a function of the instrument rather than actual difference.

De Avila (1974) a leading scholar in the area of cognitive development of Mexican American children argued that much of the difficulty with the education of Mexican American children lies in the validity of whole bound intelligence tests such as the Weschler Intelligence Scale for Children (WISC-R). His solution has been to develop measures of cognitive level and style derived from the less whole bound cognitive measures of Piaget.

It seems apparent that the issues of cognitive style as it relates to Mexican American students and the pursuit of mathematics is a rather difficult concept with which to deal. However, the interaction of these factors is one that needs further investigation. The positive relationship of field independence give us some clues as to the difficulties in teaching mathematics to Mexican American children (Ramirez, 1973) and, therefore, their pursuit of advanced math courses.

Language Environment

Another important issue regarding mathematics achievement and persistence is that of language related variables. A frequently mentioned theory is that Mexican American students have a language problem. A review of current research does not support this premise. In 1962, Peal and Lambert found that bilinguals performed significantly better than monolinguals on both verbal and non-

verbal intelligence tests. This was contrary to findings of previous investigators. Since then other researchers have supported the finding that bilinguals score as well or better than monolinguals on tests of achievement and self-concept (Cervenku, 1967; Modiano, 1973; Del Buono, 1971). Although most research indicates that bilingualism is not detrimental to intellectual function and does not cause mental disorder, educators still refuse to accept the findings.

Based on these studies the investigators found no reason to further research language proficiency or bilingualism. Thus, rather than gathering data on these areas, a more definable and relevant area of exploration seems indicated: the students' language environment. Language environment in this study consists of three facets: 1) the language orginally learned and used, 2) the language now used, and 3) frequency of usage.

Acculturation

An authoritative definition of "acculturation" was provided by a Subcommittee of Acculturation appointed by the Social Science Research Council in the mid 1930's. This group decided that acculturation encompasses those phenomena which result when groups of individuals having different cultures come into continuous first-hand contact, with subsequent changes in the original cultural

patterns of either or both groups (Redfield, et al., 1936). Mexican Americans have been frequently referred to as the least Americanized of all America's ethnic groups, least acculturated and unassimilable (Ramirez and Castanda, 1974). These descriptors are frequently used to explain the educational and economic plight of the Mexican American population. Heller (1971) suggested that Mexican American students will not succeed as long as they fail to follow the historical patterns of acculturation that have been successful for other major ethnic groups.

Educators as early as Dewey (1916) stated that one's own cultural heritage is okay, but when it has blended with others the result is even better. The message today is still conveyed: the child who has not yet "melted" is not quite good enough, the American way is something noble and finer. The extent to which this concept is exhibited in the schools is nebulous at this point. If it does exist, no research was found which indicates whether the effect is positive or negative. It seems clear, however, that degree of acculturation of Mexican American students and its relationship to persistence in mathematics is worthy of investigation.

Alienation

Alienation is a term borrowed from the sociologists that appears to play a part in Mexican Americans' avoid-

ance of mathematics. Seeman (1959) defines alienation or "powerlessness" as follows; the expectancy or probability held by the individual that his own behavior cannot determine the occurence of the outcome, or reinforcement, he seeks. Mexican Americans are often perceived as lackadaisical, self-satisfied with their subordinate role, and generally generate a "manana" attitude (Carter and Segura, 1979).

It seems likely that these traits would lead to a feeling of "apartness from society" or at best a low degree or commitment to the predominant culture. A student who feels he has no control over his future or who feels alienated from society would probably not perceive mathematics as being very useful in his adult life. No research was found that investigates this relationship but the concept of "alienation: is a common one in literature.

Value Orientation

Social scientists and educators who have investigated value orientation usually concur with Zintz (1963) that Mexican American children have the following tendencies: (1) They see success more in terms of interpersonal relationships than in terms of material acquisitions. (2) They consider time as something to be enjoyed to the fullest not to be postponed. (3) They are fatalistic in their belief of having no control over their natural or

social environment. (4) They view change as unappealing or not motivating. (5) They are submissive to the status quo and perhaps apathetic. (6) They think of work only to satisfy their present needs. (7) They attach little importance to time schedules and punctuality. (8) They attach more importance to non-scientific explanations of natural phenomena. All of these values are in direct opposition to the traditional values of the school system. Zintz suggested that Mexican American children are considered disadvantaged because they are socialized in the exact opposite values expected by school and society. These statements are obvious overgeneralizations that have led to stereotypes. Many educators and researchers hold to these tendencies as being truths and unalterable.

Two value orientations are deemed especially disadvantageous. The first is time orientation and the second is fatalism. Some empirical evidence exists to support these concerns. Carter (1968) concluded that Mexican American students are primarily concerned with the present and do not plan ahead due to uncontrollable forces. Wenhert (1966) suggested that Mexican American students tend to be less optimistic about their future than Anglo students. The fatalism found in minority studies is perceived to be a cultural adaptation to powerlessness.

These studies also suggest that Mexican American students in general are more undecided. Educators tend to believe that those who make it to the twelfth grade are more similar in value orientation to Anglos than those who quit. This leads to a presumed solution that a student who succeeds must adapt Anglo values and reject his own cultural values.

Locus of Control

Internal-External locus of control refers to the extent to which persons perceive a connection between their actions and the outcomes. People who believe that they have some control over their destinies are called Internals: that is, they believe that at least partial control resides within themselves. Externals, on the other hand, believe that their outcomes are determined by forces outside themselves, for example, by luck, chance, others, or the unpredictable.

The popularity of the IE concept is due to its wide generalizability and its social relevance (MacDonald, 1972). It has been related to such things as behavior achievement, conformity, and reaction to influence attempts. All the research points to the same conclusion: People are handicapped by external locus of control. A majority of the literature suggests that Internals engage in more goal-directed activity whereas Externals more

often exhibit non-goal-directed responses (Battle and Rotter, 1963; Lefcourt, 1966). For these reasons it seems necessary to investigate this characteristic as it relates to Mexican American students and their pursuit of mathematics.

Finally, a poorly explored factor that may be of critical importance is what Thomas Carter (1970a) refers to as access of Mexican American children to a particular profession. In this case we need to ask what accessibility do Mexican American youth have to math or math related professions? If Mexican American youth do not perceive the possibility, what effect will this have on their persistence in a math curriculum?

Other Minorities and Mathematics Avoidance

Although some research dealing with black student avoidance of mathematics is presently being conducted in the Chicago area under NIE funding, nothing of major significance was found in the literature. Wilburn (1974) supported previous findings that blacks are underrepresented in the sciences. A study comparing black and white undergraduates at Wayne State University on career influencing factors (Sie, et al., 1978), reported several interesting results. In this population, SES differences did not determine career choices. Further, the investigators were unable to determine whether people who have

some inclination towards science careers take more math or whether more math leads people into the sciences. Also, black students indicated a higher concern for future security than did white sutdents. These findings are of interest but the weakness of the data collection process lessens the impact.

In recent years numerous studies have suggested that there are sex-related differences in the studying of mathematics. This is indicated by females choosing not to enroll in math courses in high school and the lack of females in university math courses. While it is of interest to know about comparative acheivement of females and males, it is more important to gain an understanding of why so many females drop out of the math-science tract in high school. Some recent research has identified significant variables which help to gain this understanding. It is from this area of relevant research that the investigators have drawn the major premises of this proposal.

Fennema and Sherman (1976) suggest that there may be no real sex differences in aptitude at all and that differences in aptitude and achievement are the result of a failure to control for differential course taking. Why women avoid mathematics is a complex question. Several factors have been shown to be significantly related to this avoidance:

1) Career related variables (such as career knowledge, aspirations, and sex stereotyping)
2) Attitudes relating to math and self (such as anxiety toward math, self-confidence in learning math)
3) Perceptions of mathematics (such as usefulness of math, effectance motivation in math, and perceptions of math as a male domain)
4) Parents (such as attitude toward math and parental expectations for achievement in math)
5) Significant others (such as peers, teachers, counselors)
6) Demographic variables (such as race, parent educational level, school organization and course offerings).

Career related variables. Haven (1972) found that the two most significant predictors of mathematics course taking in high school for high-ability girls were the perception of usefulness of mathematics in the future and the desire to have a greater impact in natural sciences than social sciences.Sherman and Fennema (1976) supported this finding.

Fox (1975) found significant sex differences in the perceived usefulness of mathematics and career interests. Hilton and Berglund (1974) concluded that sex differences

in the perceived usefulness of mathematics resulted from the stereotyping of mathematics and related careers as a male domain. The differences in perceived usefulness between boys and girls probably results from the fact that girls are less oriented to math-related careers than boys and more oriented toward the social sciences and homemaking.

Lack of career awareness and potential is a probable cause of female math avoidance. A 1976 study of national merit scholars indicated that sex was the single best predictor of career aspirations (Ory and Helfrich, 1976). It is a common belief that marriage and careers in the sciences are not compatible for women (Rossi, 1965). Lack of appropriate role models for girls limit their career choices.

Knowledge about the relevance of mathematics to real life is lacking in most math curricula. When girls or Hispanics are faced with decisions about course taking they are likely to seek advice from significant others. The problem for Mexican American students may be a chronic absence of career awareness and career role models. This would produce a vacuum of personal career aspirations in math-related occupations.

Attitudes relating to math and self. To understand why a person acts a certain way in a given situation, one

must first understand the persons' attitude toward the situation, the self-concept as it relates to the situation and the personal values. In the case of the Hispanics' avoidance of math, one must try to understand the attitudes toward math, toward themselves as learners of math, and the values which shape their attitudes.

One tends to pursue those things which produce a feeling of confidence and success. Fennema and Sherman (1976) found a strong relationship between self-confidence as a learner of mathematics and the pursuit of advanced math courses. It should be noted that it is self-confidence with respect to mathematics and not a general self-esteem that appears to make a difference (Adamo and Fitk, 1972).

Anxiety is one of the most important affective variables relating to differences in mathematics learning (Fox, 1976; Tobias, 1976; Fennema, 1974). Callahan and Glennon (1975) concluded that anxiety and mathematics are related. Although self-confidence and anxiety are usually thought of as independent variables, it seems that in relation to mathematics they are one and the same. It therefore appears reasonable to believe that a lower confidence level and higher anxiety toward mathematics helps explain sex related differences in the pursuit of advanced courses. This factor may also be a significant predictor of Hispanics' pursuit of advanced math classes.

Perceptions of mathematics. The perceived usefulness of mathematics is an affective variable that deserves consideration. Sex differences in the perception of usefulness of mathematics has been reported as early as seventh grade (Hilton and Berglund, 1974). However, the differences between male and female perception of usefulness was not as great in Fennema and Sherman (1976) as in Hilton and Berglund. It is possible that awareness of sex-role appropriate behavior, adolesence and seventh grade all occur simultaneously. It is then not hard to understand that at this point girls begin to perceive themselves as less competent than boys. Their perception of the need for mathematics could certainly be tied to this event.

Effectance motivation is defined as the student's perception of the intrinsic value of mathematics. This quality encourages learners to participate in mathematics at higher levels because of its own appeal to the student. Problem solving is a challenge. Some believe that females are not as fascinated by problem-solving activities as males (Kagen, 1964). Fennema and Sherman, however, found no difference at any levels. The question of intrinsic motivation of mathematics is still a nebuous area of research.

Math as a male domain is a commonly accepted stereotype. Math oriented activities are more appropriate for males than females. The differences in perception begin early (Boswell, 1979) but do not become significant until acolesence (Stein, 1971). Fenneman-Sherman (1976) addressed this issue. They reported that boys more than girls rated math as a male domain. They also suggested that this view is communicated to girls thus reinforcing the female perception and avoidance of math.

Perceived usefulness of math, intrinsic motivation of mathematics and math as a male domain are proven predictors of girls pursuit of mathematics courses. It seems not only logical but also probable that these factors are somewhat related to the Hispanic avoidance. This study will investigate usefulness, motivation and Anglo dominance perceptions of Hispanic students.

Parent related variables. Some evidence exists that support and encouragement from parents is crucial for girls in their decisions to pursue or avoid math in high school (Haven, 1972; Luchins, 1976). Fox (1975) found highly able boys more likely to perceive their parents as favorable towards math than girls. Fenneman-Sherman (1976) also found sex differences in students' accounts of parent support.

The influence of fathers seems to be greater for girls than that of mothers (Haven, 1972). A study of high

school students (Ernest, 1976) found that both male and female students relied more heavily on their fathers for help with mathematics. Carlsmith (1964) found that mathematics achievement was lower in father-absent homes. This indicates that fathers have a great influence on students' pursuit of math regardless of sex.

Levine (1976) reported that parents hold lower educational goals for their daughters than their sons. This study also indicated that mothers accept their daughters' lack of success in math because of their own lack of competence. On the other hand, Stein and Bailey (1973) concluded that the presence of an achieving maternal model was an influential factor. This was again supported by Erickson and Nordin (1974) and O'Donnel and Anderson (1978) who found mothers' educational level was a predictor of math pursuit. Aiken (1975; 1976) concludes that lack of salient female role models engaged in mathematical careers leads girls to think of themselves as incompetent.

These studies suggest that perceived parental attitudes towards math and expectations of achievement in math along with educational background of mothers account for a portion of girls avoidance of mathematics. It is the purpose of this study to determine the effects of these factors on another minority group--Hispanics.

Significant others. There is an observable absence of Hispanic students in the math-science related careers due in large part to their reluctance or refusal to study advanced math in high school. Some successful intervention is necessary to ensure equalization in mathematics for all minorities. However, more information is needed about critical school related variables.

From kindergarten through high school students spend thousands of hours in contact with teachers. While other school factors may be influential, it is this consistencey of interaction with teachers that is the main influence on students in the educational setting. A major part of the teachers' influence is in the student's development of role standards in mathematics. If the student received verbal or nonverbal messages from the teacher concerning his lack of ability or inappropriate role behavior, the student will surely live up (down) to them. The investigators believe that this influence is exhibited through differential treatment of Hispanics as well as in expectations of Hispanic achievement in mathematics.

Schonborn (1975) found many studies that indicate teachers treat girls differently than boys. One major study (Good, Sikes and Brophy, 1973) showed that teachers give high achieving males much more attention in math class than any other group. The investigation of the

relationship between teacher behavior toward minority students in math classes, math teachers as possible role models for minority students and decisions to pursue higher levels of math seems crucial.

Females are more likely than males to seek career advice from counselors regarding advanced math courses (Harway, Astin, et al., 1976). This creates a problem in that numerous other sources report that girls receive minimal if not negative encouragement from counselors to pursue math courses or nonstandard careers (Casserly, 1975; Christman, et al., 1976; Haven, 1972). Luchins (1976) and Casserly (1975) stated that counselors had admitted encouraging girls to avoid math classes. The chance exists that this stereotyping on the part of counselors about those who are successful in mathematics is also exhibited in their advisement of Mexican American students.

Peer influence is another affective variable that gives cause for concern. Studies indicate that in the case of girls and mathematics persistence, peers exhibit a great deal of influence (Shapiro, 1962). This occurs especially in male-female interaction. Adolescent girls become aware that math is a male domain and implies lack of femininity should they persist. One study indicated that female college students are more concerned about male

perception of their femininity than female perceptions (Husbands, 1972). Girls did not date boys in their advanced level math courses in high school (Casserly, 1975). This same study reported that girls place great importance upon female support to help deal with the disapproval of males.

Peer pressure has long been known as a powerful influence on students in a social setting (Poffenberger and Norton, 1959). Just as has been shown the case with girls and mathematics, so it seems likely to be with Mexican Americans. Considering the strength of their culture it could be a very strong predictor of persistence in the nonstandard math/science areas.

Demographic variables. Although no evidence was found which specifically relates avoidance of mathematics by Hispanics' to socio-economic status, it seems to be a logical variable to study. SES has long been used as an explanation for lack of achievement of all minorities. It is the intent of this study to examine SES in terms of students who have proven achievement in mathematics and test it as a predictor of their pursuit of mathematics.

School organization is a demographic variable that has shown some effect on girls persistence in math. There are those who report better achievement for girls in all-female classes (Hurley, 1964; Fox, 1974). Conway (1973)

and Husbands (1972) argue very strongly against sex-segregation on the grounds that it results in inferior education due to lowering of teacher-expectations and watering down of courses. This would be much like the effects of segregating blacks in our schools.

A more acceptable alternative is having programs that track early on those students who show high ability in math. This kind of academic program leads to the pursuit of advanced math and science courses (Fox, 1975). Early tracking also leads to peer group support and reinforcement of each other. The ultimate would be to require four years of high school math from everyone. This would eliminate any student from having to defend the pursuit of math (Farley, 1968). School organization and course offerings seem to be valid variables for investigation in determining those predictors of Hispanics' pursuit of mathematics.

Choice of Occupation and Career Decisions

Since the amount of high school mathematics becomes a natural sieve for future careers and occupations, it was deemed helpful to review the research pertaining to career choices and decisions. Although nothing was found which relates specifically to Mexican American occupational choices, some relevant generalizations can be made.

Lunneborg (1975) found that no sex differences existed in career decision making styles. The frequency of those falling into Harren's (1976) three styles of career decision making, 1) Planning, 2) Intuitive, and 3) Dependent was equally divided among male and female. Most fell into the Intuitive (gut feeling) category. This finding supported the earlier work of Lawrence and Brown (1976). It appears, then, that approaches to career decisions do not differ between male and female students.

Neice and Bradley (1979) concluded that age is a significant variable in career decisiveness. As age increases so does self-awareness and career decisiveness. This finding implies a need for further research in plotting over time factors affecting career decisions.

The most helpful outcome of the review of career/decision literature is an awareness of key occupational decision making instruments. These include: Assessment of Career Decision Making (Harren, 1976); Vocational Rating Scale (Barrett and Tinsley, 1977); Career Decision Questionnaire (Lunneborg, 1977); The Occupational Aspiration Scale (Haller and Miller, 1971); and A Scale of Career Indecision (Osipon, et al., 1976). A thorough study of these instruments will provide needed career oriented insight toward the development of instruments for this study.

Summary

The question of whether or not there are cultural differences in the avoidance of higher level mathematics is indeed more complicated than it appears. There is obvious data to indicate that few Mexican American students pursue advanced mathematics study and choose careers that involve mathematics. However, it is not clear as to whether this underrepresentation of Hispanics is due to lack of awareness of the importance of mathematics or to a definite choice not to pursue it. By controlling for ability in this study, the investigators will be able to determine which of the identified variables influence course taking and to what degree.

Based on the research reported here, the following independent variables were chosen:

1) Career related variables,
2) Attitudes relating to math and self,
3) Perceptions of mathematics,
4) Parental attitudes,
5) Significant others,
6) Demographic variables,
7) Cognitive style,
8) Language environment,
9) Acculturation,
10) Alienation,
11) Value orientation, and
12) Locus of control.

Chapter III

Procedures

Definition of Variables

Based upon a review of the literature, a tentative list of variables which may affect mathematics participation was developed. These were grouped into logical categories such as parental attitudes, acculturation, cognitive style, locus of control and influence of significant others. Existing studies and relevant articles were reviewed by the staff, and definitions of each variable were constructed. At this point the first draft of each scale was written. Definitions of all final survey variables are included in Appendix A.

Instrument Construction

The project staff and outside consultants reviewed and refined existing definitions and existing scales for completeness, item quality and relevancy. Areas were identified in which additional items were needed or in which too many items existed. Names and affiliations of consultants to this project appear in Appendix E.

In March of 1981 all items and scales were field tested locally by approximately thirty high ability eighth grade students: 15 Anglos, 15 Mexican Americans. The items were packaged in one booklet and given to all

students at the same time. Based upon the results of this administration the survey was revised in terms of length, clarity and validity of the questions. The revised questionnaire was administered again in May 1981 to a similar group of students.

Following the second administration, the staff and consultants met to finalize the items and scales. Scales were inspected for polarity to insure as many positive as negative items. Final selection of items depended on the contribution of each item to that scale. Items that were repetitious were rejected by selecting the more effective of the two. The group wanted to be sure that all seemingly important variables were included in the final form, thus a large degree of logical analysis was in order. For example, it was felt that anxiety toward math was isolated or just a part of a general anxiety toward special areas.

Student Survey

The survey items (211) were packaged into one booklet. Items were organized into the following six categories:

I. Aspirations

II. Attitudes Toward School

III. Related Facts

IV. Parental Influences

V. Influence of Significant Others

VI. Self-Descriptors

Appendix B includes the survey items used in this study. The numbers in parenthesis indicate where the item is found in the questionnaire. Source documentation for attitude items appears in Appendix C.

Sample Description

Upon completion of field testing and validation of the instrument, the random sample was chosen. Many Mexican American students who have high math ability decide to avoid the subject and thus lock themselves out of professions and careers that are math related. For this reason, the sample consisted of only high ability students in an attempt to identify specific causes for their lack of persistance given the fact that they could do the work if they choose to do so.

In April 1981 the State Department of Education administered the California Achievement Test (CAT) to all students in grades K-12. They released to us a listing of schools and school districts with a break down of Anglo and Mexican American students along with their test scores. This was of great service to the study and saved much time and energy.

Three sample populations were selected from this listing--students who were in the 8th, 9th and 10th grade

at the time of testing. The survey was administered to three age groups in an attempt to detect changes in attitude and achievement over a three year span of high school. Eighth grade is the end of compulsory education and represents the time when most students choose whether to pursue mathematics in high school or take their one required course and avoid further math courses. Students beginning the eleventh grade would have decided the number of courses they were going to take in their four years of high school and would have a more developed set of attitudes and aspirations. Thus, this cross section of students would give us specific answers to pertinent questions.

The sample was a statewide selection of approximately 115 Mexican American students entering grades 9, 10, and 11 in the fall of 1981. The students were in the top three stanines on the CAT. A matched comparison group of Anglo students were selected using the same criteria, making a total of almost 700 students across the state to be tested. The sample selection accounted for size of school and geographic setting to insure that no important factors would be missed by lack of inclusion in the sample. A listing of schools and school districts used appears in Appendix F.

Administrative Procedures

Upon selection of the sample, appropriate school personnel were contacted and parent permission was secured. In total, 31 schools and 18 school districts around the state were involved. Research assistants administered the survey booklets and the cognitive style test to eligible students at each school between October 1 and November 15, 1981. All students in a school were brought together in a central location and tested as a group. Also, students were asked to take a letter home requesting parental permission in a follow-up interview.

Students were paced through the 90 minute session by the test administrators to assure that they would finish all survey items and to time the 20 minute cognitive style test. Additional background information was gathered at each school (e.g., school enrollment, number of math classes offered).

Responses were made directly on the survey to avoid transfer errors. Each survey was then coded and results were transferred to computer tapes. The tape was then put into the ASU computer for analysis.

Approximately 280 families responded positively to our request for a one hour interview with each parent and the student involved. From those responding, twenty-five families were chosen based on location, geographic setting,

student's sex, and availability. The purpose of the personal interviews was to serve as (1) an error check for the student questionnaire and (2) a source of additional culturally relevant information. The seventy-five interviews were collected between March 1 and May 31, 1982. Additionally, two-page questionnaires were sent to those responding positively but not selected for personal interviews. The written questionnaire is found in Appendix G. A more extensive description and analysis of the interviews is presented in Chapter VI.

Instruments

The student survey was designed to measure which of the possible decision factors were indeed influential in the student's decision to persist in mathematics at the time of administration. Various paper and pencil formats were used. Some questions were completion but most were of the 5 option Likert type (strongly agree to strongly disagree). Response options were assigned a one to five point value with five representing a strong positive attitude. An interpretation of scores on each scale appears in Appendix A.

Several resources were used to construct this instrument including the Fennema-Sherman Mathemetics Attitude Scale (1976) which has been modified by Armstrong (1979) and the various career related instruments. The instru-

ment was administered at the beginning of the 1981-82 school year.

The Group Embedded Figures Test was used to determine cognitive style. The version is that adopted by the National Longitudinal Study of Mathematics Abilities (NLSMA) from the Educational Testing Service original (French, Ekstuem, and Price, 1963).

Description of Variables

Various student aspirations constituted the first category of variables. Occupational aspirations was measured by a four question scale asking both idealistic and realistic expectations of future careers. Students were also asked to specifically describe the occupation indicated most desirable as their life's work. Finally, they indicated the relative importance of a list of factors that might influence career decisions and gave an estimate as to the amount of math and science that would be needed in their chosen career.

Level of educational aspirations was measured by a two item scale asking idealistic and realistic expectations. Additionally, respondents were asked the importance of six factors in making decisions about college attendance. One item asked students to list the three most important factors leading to a decision not to go to college.

The second category of variables, attitudes toward school and math, consisted of six Likert scales. Six items measured perceived usefulness of mathematics in daily life and in career or educational plans. A six item confidence in mathematics scale noted the existence of a potential to do well in mathematics. A mathematics anxiety scale contained six items that dealt with feelings in doing mathematics and taking additional math courses. In order to determine whether anxiety was mathematics-specific, a six item scale was developed to measure anxiety about school, English and Science. Enjoyment of mathematics was measured by a four item scale.

Mathematics as an Anglo domain was a stereotyping scale (four items) that measured the extent to which students regard mathematics as more appropriate for Anglos than for Mexican Americans. Finally, respondents indicated the relative importance of seven factors in decisions about taking additional mathematics courses.

A series of questions dealing with related facts or pertinent data comprised the third area of study. The first item asked students how many years of mathematics they planned to take during high school. This item was used as one of the dependent variables. For comparison purposes, an additional question elicited a similar response regarding the number of years of planned science participation in high school.

Family (marital) status was determined in order to evaluate differing effects of parental influence. Single-parent influences might differ from two-parent or guardian type arrangements. A second question asked frequency of visitation with the parent not lived with, indicating an opportunity for influence.

A composite of responses to father's occupation and education, mother's occupation and education together with a list of ten items found in the home was used to devise a measure of socioeconomic status (SES). Parallel items were used for mother and father separately. Nine categories were used for educational attainment and nine categories were used to determine parental occupations. Respondents indicated whether they had or did not have the ten items in their home.

A series of questions determined which math courses students had taken or were taking. The level of termination of math courses determined into which of three categories of participation students were placed. The lowest category contained those who had completed one course lower than Algebra I. Category two contained those who had completed Algebra I and the third category included those who had completed Algebra II or Geometry.

A second series of questions evaluated which specific math courses students planned to take during their four

years of high school. This item served as a second source of intended participation and was likewise used as a dependent variable. Students were also asked if they took algebra while in the eighth grade. A positive answer would indicate a possible tracking system in mathematics and might be a factor leading to the variation in course enrollments between Mexican Americans and Anglos.

Three additional background questions were asked. One item asked students to choose from five categories the grades they typically received in mathematics. A second item asked their plans to take college preparatory math classes. These two items were used as dependent variables three and four. A final item asked whether their primary emphasis in high school courses was vocational, college prep or general.

Research indicates that parents have an effect on their children's course-taking, achievement and attitudes. In the fourth category of variables, parental influences, two effects were measured; passive influence and active influence. Separate but parallel scales were used for mother and father role modeling and encouragement.

Two short scales dealt with student perceptions of the examples set by their parents (passive influence) in terms of parental abilities and use of mathematics. Another pair of scales measured perceptions of overt (active influence) parental encouragement and support.

Two single items checked for parental stereotyping of mathematics. The students were asked if parents felt math was more for Anglos than for Mexican Americans. Another item checked to see which parent helped the student more with mathematics homework.

Parental educational expectations for their children was measured by two items. The choice of levels of advancement were identical to those in the item measuring the students' own educational aspirations.

The final area in this category dealt with older brothers or sisters who might be influencing the respondent. Two items determined the existence of an older sibling who might be somehow encouraging the younger sibling to pursue mathematics.

Influence of significant others, peers, teachers and counselors, was the topic of category five. Peer influence was measured by a six-item scale asking what effect being "good" in mathematics has on relationships with friends. A negative effect might influence the student to hide success in mathematics or avoid it altogether. The peer stereotyping scale paralleled the two items in the parent section. These asked whether their friends thought mathematics was more for Anglos than for Mexican Americans.

Teachers influences were measured in regards to encouragement, stereotyping, and differential treatment in mathe-

matics. Four items surveyed students' feelings regarding direct encouragement given them by their teachers. One stereotyping question asked whether teachers behaved as though mathematics was more for Anglos than for Mexican Americans. Research has shown that teachers treat Mexican American students differently than Anglo students. This scale contained six questions in an attempt to identify possible signs of differential encouragement or expectations that may affect future persistence in mathematics.

A single item determined the degree to which a counselor had encouraged or discouraged a student to study mathematics.

Variable six contained six scales measuring different attributes or self descriptors of the respondent. Eight items were used to measure Locus of Control. Research suggests that achievement is associated with an external locus of control.

Language environment was defined in terms of three facets: language background, language experience and perceived effects of a Spanish accent. Language background investigated development and usage--preschool and now. Language experience determined the frequency of encounters with written or spoken Spanish. Two questions assessed students' perceptions of the effect a Spanish accent had on their achievements in school.

A five item scale measured the respondents degree of alienation or "apartness from society". Research suggests that persons with a low degree of commitment to the predominant culture would not perceive mathematics as being useful in their adult lives. This scale placed students on an alienation continuum.

The literature suggests that the typical classroom is structured to fit the needs of middle-class Anglo students. This implies that a successful Mexican American student must possess the ability and the desire to participate in "the system" as it exists and therefore is considered totally acculturated into the Anglo society. The twenty-one questions in this scale explored the degree of student acculturation.

Cognitive style was another "self-descriptor" that may have been affecting student persistence in mathematics. Cognitive style is used to formulate the idea that people think and process information in different ways. Some people process information so that the smallest details almost always stand out (field-independent). Others overlook small details and see instead the whole picture (field-dependent) or overall context. The "Group Embedded Figures Test" was used to determine cognitive style of the respondents (see exact source information in Appendix C).

Analysis of Survey Data

Data analysis were performed to provide statistical answers to the following research questions:

1. What study variables constrict students' math-related career decisions?

2. What is the degree of influence of the study variables on persistence and achievement in mathematics?

3. Are the study variables and their degree of influence stable over time?

Results for these questions will be discussed in Chapter IV. An extensive path analysis appears in Chapter V.

CHAPTER IV

Statistical Analysis

Introduction

In this chapter, results of the survey of high achievers will be reported. First, a description of the sampling procedure and the characteristics of the sample will be given. Secondly, the method used for the construction of indices and other composite variables will be discussed.

In the statistical analysis of the data, we began with a series of analysis of variance tests with ethnicity, grade level and sex as independent variables to determine differences among sub-groups of respondents in terms of educational expectation, parental support, attitudes toward mathematics and other variables. A factor analysis was conducted to determine what the respondents considered as the most important factors in career decision-making. A more extensive analysis of the Mexican American sub-sample by means of discriminant functions was then conducted. Finally, we tested an elaborate path model of mathematics achievement and persistence.

Sampling Procedure and Sample Characteristics

The results of the mathematics portion of the California Achievement Test for the 1980-81 academic year were used to identify students in the ninth, tenth and

eleventh grades who scored in the seventh, eighth and ninth stanines. From these results, a list of high schools in the State of Arizona with at least 5 Mexican American students scoring at the seventh stanine or above was compiled. Cooperation was obtained from selected schools to administer the survey questionnaires (see Appendix F for a list of schools in which the survey was conducted). The survey was then administered in a central location at each school in the fall of 1981.

The sample shows the following characteristics:

(1) About 90% of the respondents were evenly divided between the ages of 14, 15, and 16. The sample was also evenly distributed between the ninth, tenth and eleventh grades.

(2) Most of the respondents had high overall mathematics grades. Over 40% had an A average and almost 50% had a B average in mathematics courses.

(3) Almost 50% plan to attend a 4-year university while almost 20% plan to go to graduate school.

(4) In terms of occupation, over 80% would like to become a professional.

(5) There were slightly more females (53%) in the sample than males (47%).

(6) Most of the respondents planned to take a lot of mathematics courses in high school, with 60% stating that they would take 4 years of high school mathematics and 23% stating they would take 3 years.

(7) Over 70% planned to take college preparatory courses in mathematics.

(8) Twenty-four respondents did not indicate their ethnicity. Of the 670 respondents who did, 48% were Mexican American and 52% were Anglo.

(9) The data on father's educational attainment shows that about one-fourth did not graduate from high school, about one-fourth graduated from high school, about one-fourth had some college, and about one-fourth graduated from college. The fathers of Mexican American students tended to have lower educational attainment than Anglo fathers.

(10) The mean score on the Group Embedded Figures Test (cognitive style) was 12.17 and the standard deviation was 4.37. The maximum score on the test was 18.

(11) For the Mexican American sub-sample, about three-fourths spoke mainly English, and one-fourth spoke English and Spanish equally or spoke Spanish primarily. About 40% of the Mexican Americans stated that they could speak Spanish fluently or very fluently.

In summary, the sample contains roughly the same proportion of males and females, as well as Mexican Americans and Anglo Americans. While the educational background of the respondents' fathers shows that a large percentage were not college graduates, our sample of high achievers have high educational and professional expectations. Most of them planned to go to a university and to pursue a professional career. Most of them were doing well in their high school mathematics courses, and a large percentage of them expected to take college preparatory mathematics courses. However, their scores in the Group Embedded Figures Test showed a wide range of variations, indicating perhaps that their is a corresponding wide range of potential among the respondents for achievement in a mathematics career.

The Construction of Indices

A number of additive indices were constructed by combining questions which pertain to the same concepts. Before constructing these, it was determined that questions to be included in a particular index were highly correlated with each other ($r \geq .5$). The theoretical origins of some of these have previously been discussed in Chapter I.

The indices can be divided into the following sets:

(A) Subject's locus of control. There are two indexes in this set. The first is the Locus of Control Index, the second is the Alienation index. Items for these two indexes were selected from previous social science research on these two concepts.

(B) Subject's attitudes toward school and mathematics. There are eight indexes in this set:

1. Important of Mathematics
2. Confidence in Mathemtics
3. Enjoyment in Mathematics
4. Mathematics Anxiety
5. School Anxiety
6. English Anxiety
7. Science Anxiety
8. Overall Index of Self-Attitudes Toward Mathematics.

The Overall Self-Attitudes Toward Mathematics Index was constructed by combining four indexes:

1. Importance of Mathematics
2. Confidence in Mathematics
3. Enjoyment in Mathematics
4. Mathematics Anxiety.

(C) Subject's perception of support in mathematics and education by significant others. Eight indexes were constructed in this category:

1. Mother as Educational Role Model
2. Father as Educational Role Model
3. Parents as Educational Role Model (combination of the first two indexes)
4. Parent's Educational Expectation
5. Peer Influence on Subject's Academic Performance
6. Teacher's Influence on Subject's Academic Performance
7. Teacher's Differential Treatment
8. Sibling as Educational Role Model.

(D) Subject's persistence in mathematics. This area contains two indexes:

1. Number of Mathematics Courses Completed
2. Number of Mathematics Courses Subject Plans to Take.

(E) Language use. Two indexes were constructed. The first index consists of questions on how much the subject reads in Spanish, watches Spanish television and listens to Spanish radio stations. The second index measures how fluent the subject is in terms of speaking, reading and writing Spanish.

The content of these indices are listed in Appendix I.

Analysis of Variance Tests on Selected Variables

In order to determine if significant differences exist between selected variables based on ethnicity, sex and grade level, a series of analysis of variance tests was conducted.

In Table 1, the results of a series of one-way analysis of variance tests on the relationship between ethnicity and a number of variables are presented. The dependent variables are divided into two sets. The first set pertains to the respondent's attitudes about significant others. Using the .05 level of significance, it was found that Mexican Americans felt that parents were less supportive as educational role models; on the other hand, Mexican Americans were more affected by authority figures (teachers and parents) in their selection of career choices.

Table 1

One-Way Analysis of Variance on Selected Variables With Ethnicity as Independent Variable

Dependent Variables	Significance of F
A. Pertaining to Significant Others	
Parents As Role Model	0.05
Parents' Educational expection	N.S. (at .05 level)
Teachers' Influence	N.S.
Teachers' Differential Treatment	N.S.
Authority Figures' Influence on Career Choice	0.01
Peer Influence	N.S.
Sibling As Role Model	N.S.
B. Pertaining to Respondents	
GEFT Score	0.04
Alienation	N.S.
Locus of Control	N.S.
Ethnic Occupational Stereotype	0.03
Occupational expectation	N.S.
Educational expectation	0.03
Overall Self-Attitudes Toward Math	N.S.
Math Courses Planned	N.S.
Math Courses Completed	N.S.
Years of Math to be Taken	N.S.
Math grades	N.S.
Math College Preparatory Plan	N.S.
English Anxiety	0.5
Science Anxiety	0.007
Math as Anglo Domain	< 0.0001

The dependent variable analysis pertaining to the respondents' attitudes about themselves and their mathematics persistence/achievement, indicates that while Anglos had higher mean GEFT scores, no significant difference was found on mathematics persistence or achievement. We also found that Mexican American students disagreed more strongly with ethnic occupational stereotypes and stereotyping mathematics as an Anglo domain. In terms of educational goals it was found that Mexican Americans had somewhat lower expectations. Specifically, a somewhat larger proportion of Mexican Americans planned to attend a two year college rather than a four year college when they finished high school. Finally, although there was no significant differences in terms of mathematics attitudes, Mexican Americans had a high mean level of anxiety toward English and Science.

Next, a two-way analysis of variance with ethnicity and grade level as independent variables was administered. In Table 2, it can be seen that the grade level of the respondent has a significant effect on parents' educational expectation, but ethnicity has no effect. As the respondents progress to the higher grade levels, parents' educational expectations increased significantly.

Table 2

Two-Way Analysis of Variance Effects of Grade and Ethnicity on Parents' Educational Expectation

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects	76.226	3	25.409	6.915	0.000
Grade	75.375	2	37.687	10.257	0.000
Ethnicity	1.123	1	1.123	0.306	0.581
2-Way Interactions	3.413	2	1.707	0.464	0.629
Grade Ethnicity	3.413	2	1.707	0.464	0.629

Table 3 shows that ethnicity had an effect but grade level had no effect on respondent's perception of how positively their parents serve as educational role models. Mexican American students' perceptions were less positive.

Table 3

Two-way Analysis of Variance Effects of Grade Level and Ethnicity on Parents as Role Models

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects	2.277	3	0.759	1.974	0.117
Grade	0.300	2	0.150	0.390	0.677
Ethnicity	1.998	1	1.998	5.197	0.023
2-Way Interactions	1.202	2	0.601	1.562	0.210
Grade Ethnicity	1.202	2	0.601	1.562	0.210

Both grade level and ethnicity significantly affected the respondents educational expectations (see Table 4). Mexican American's had lower expectations.

As students moved to higher grade levels, their expectations increased. There was no interaction between grade level and ethnicity.

Table 4

Two-Way Analysis of Variance Effects of Grade Level and Ethnicity on Educational Expectation

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects	17.663	3	5.888	4.875	0.002
Grade	10.245	2	5.123	4.242	0.015
Ethnicity	7.750	1	7.750	6.417	0.012
2-Way Interactions	3.255	2	1.627	1.347	0.261
grade Ethnicity	3.255	2	1.627	1.347	0.261

Table 5 shows that neither grade level nor ethnicity had a significant effect on overall attitudes toward mathematics.

Table 5

Two-Way Analysis of Variance Effects of Grade Level and Ethnicity on Overall Attitudes Towards Mathematics

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects	0.919	3	0.306	1.069	0.362
Grade	0.919	2	0.459	1.603	0.202
Ethnicity	0.000	1	0.000	0.001	0.976
2-Way Interactions	0.173	2	0.086	0.302	0.740
Grade Ethnicity	0.173	2	0.086	0.302	0.740

Upon examing the effects of grade level and ethnicity on mathematics persistence, the only significant finding as shown in Table 6, was that grade level had an effect on

the respondents' mathematics course plans, i.e., as they move up in grade level, they tended to increase the number of mathematics courses which they planned to take. No other significant effect of ethnicity and grade level on mathematics persistence was found.

Table 6

Two-Way Analysis of Variance Effects of Grade Level and Ethnicity on Math Course Plan

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects	55.151	3	18.384	3.763	0.011
Grade	51.587	2	25.793	5.279	0.005
Ethnicity	4.010	1	4.010	0.821	0.365
2-Way Interactions	1.658	2	0.829	0.170	0.844
Grade Ethnicity	1.658	2	0.829	0.170	0.844

A series of three-way analysis of variance tests was also conducted with grade level, ethnicity and sex as independent variables. Table 7 shows that ethnicity had an effect ($p < .05$ level) on the respondents perception of how positive their parents are as educational role models. Mexican Americans had less positive perceptions, confirming the results of the one-way and two-way analysis of variance tests.

Table 7

The Effects of Grade Level, Ethnicity and Sex on Parents as Role Models

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects	3.498	4	0.874	2.270	0.060
Grade	0.231	2	0.115	0.300	0.741
Ethnicity	2.085	1	2.085	5.411	0.020
Sex	1.221	1	1.221	3.168	0.076
2-Way Interactions	1.561	5	0.312	0.810	0.542
Grade Ethnicity	1.134	2	0.567	1.471	0.230
Grade Sex	0.390	2	0.195	0.506	0.603
Ethnicity Sex	0.001	1	0.001	0.002	0.961
3-Way Interactions	0.273	2	0.137	0.354	0.702
Grade Ethnicity Sex	0.273	2	0.137	0.354	0.702

Table 8 shows that grade level affected parents' educational expectations of the respondents, but ethnicity and sex had no effect. The higher in the grades the student progresses, the higher are the parents' educational expectations.

Table 8

The Effects on Grade Level, Ethnicity and Sex on Parents' Educational Expectations

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects	78.462	4	19.615	5.347	0.000
Grade	73.853	2	36.927	10.066	0.000
Ethnicity	1.212	1	1.212	0.330	0.566
Sex	2.236	1	2.236	0.609	0.435
2-Way Interactions	24.290	5	4.858	1.324	0.252
Grade Ethnicity	3.341	2	1.670	0.455	0.634
Grade Sex	20.157	2	10.079	2.747	0.065
Ethnicity Sex	0.721	1	0.721	0.196	0.658
3-Way Interactions	2.720	2	1.360	0.371	0.690
Grade Ethnicity Sex	2.720	2	1.360	0.371	0.690

Table 9 shows that both grade level and ethnicity affected the respondents' educational expectations, thus confirming the results obtained from the two-way analysis. In addition, the two-way interactions between grade level and sex were significant at the .005 level. Whereas in the ninth and tenth grades, girls had higher educational expectations than boys, in the eleventh grade the pattern was reversed.

Table 9

The Effects of Grade Level, Ethnicity and Sex On Educational Expectations

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects	20.687	4	5.172	4.341	0.002
Grade	10.978	2	5.489	4.607	0.010
Ethnicity	7.517	1	7.517	6.309	0.012
Sex	3.023	1	3.023	2.538	0.112
2-Way Interactions	17.093	5	3.419	2.870	0.014
Grade Ethnicity	2.923	2	1.462	1.227	0.294
Grade Sex	12.531	2	6.265	5.259	0.005
Ethnicity Sex	1.044	1	1.044	0.976	0.350
3-Way Interactions	0.847	2	0.424	0.356	0.701
Grade Ethnicity Sex	0.847	2	0.424	0.356	0.701

The implication found here that boys overtake the girls in the eleventh grade in terms of educational expectations should be examined further in future research on sexual differences in educational persistence. The effects of grade level, ethnicity and sex on overall attitudes toward mathematics are examined in Table 10.

Table 10

The Effects of Grade Level, Ethnicity and Sex on Overall Attitudes Toward Mathematics

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects	2.665	4	0.666	2.362	0.052
Grade	0.921	2	0.461	1.633	0.196
Ethnicity	0.000	1	0.000	0.001	0.969
Sex	1.746	1	1.746	6.189	0.013
2-Way Interactions	2.710	5	0.542	1.921	0.089
Grade Ethnicity	0.149	2	0.074	0.264	0.768
Grade Sex	2.382	2	1.191	4.221	0.015
Ethnicity Sex	0.178	1	0.178	0.631	0.427
3-Way Interactions	0.280	2	0.140	0.497	0.609
Grade Ethnicity Sex	0.280	2	0.140	0.497	0.609

Sex was found to have a significant effect on attitudes toward mathematics. Females had less positive attitudes (in terms of confidence, enjoyment, anxiety, and feelings about the importance of mathemtics) toward mathematics than males. There was also a significant two-way interaction between sex and grade level. While males developed a progressively more positive attitude toward mathematics as they moved up to the higher grade levels, the reverse was true for females.

Tables 11, 12, 13, and 14 examine the effects of grade level, ethnicity and sex on mathematics persistence and achievement. The results confirm the two-way analysis of variance effects of grade level and ethnicity; i.e., ethnicity has no effect and grade level effects the number of courses planned. In addition, it was found that sex had an effect on the number of years of mathematics the respondents plan to take in high school. No significant interaction effects were found between grade level, ethnicity and sex.

Table 11

The Effects of Grade Level, Ethnicity and Sex on Math Courses Planned

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects	64.778	4	16.195	3.310	0.011
Grade	53.833	2	26.917	5.502	0.004
Ethnicity	3.670	1	3.670	0.750	0.387
Sex	9.627	1	9.627	1.968	0.161
2-Way Interactions	12.448	5	2.490	0.509	0.770
Grade Ethnicity	1.635	2	0.817	0.167	0.846
Grade Sex	10.941	2	5.470	1.118	0.328
Ethnicity Sex	0.025	1	0.025	0.005	0.943
3-Way Interactions	4.770	2	2.385	0.487	0.614
Grade Ethnicity Sex	4.770	2	2.385	0.487	0.614

Table 12

The Effects of Grade Level, Ethnicity and Sex on Number of Years of Mathematics Respondents Plan to Take

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects	3.079	4	0.770	1.165	0.325
Grade	0.108	2	0.054	0.082	0.921
Ethnicity	0.003	1	0.003	0.005	0.946
Sex	2.885	1	2.885	4.365	0.037
2-Way Interactions	3.529	5	0.706	1.068	0.377
Grade Ethnicity	0.484	2	0.242	0.366	0.694
Grade Sex	0.595	2	0.297	0.450	0.638
Ethnicity Sex	2.201	1	2.201	3.330	0.068
3-Way Interactions	1.179	2	0.590	0.892	0.410
Grade Ethnicity Sex	1.179	2	0.590	0.892	0.410

Table 13

The Effects of Grade Level, Ethnicity and Sex on College Preparatory Plans in Mathemtics

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects	0.270	4	0.067	0.329	0.859
Grade	0.148	2	0.074	0.362	0.696
Ethnicity	0.028	1	0.028	0.135	0.714
Sex	0.108	1	0.108	0.525	0.469
2-Way Interactions	1.117	5	0.223	1.091	0.364
Grade Ethnicity	0.447	2	0.223	1.091	0.336
Grade Sex	0.482	2	0.241	1.176	0.309
Ethnicity Sex	0.191	1	0.191	0.932	0.335
3-Way Interactions	0.001	2	0.001	0.003	0.997
Grade Ethnicity Sex	0.001	2	0.001	0.003	0.997

Table 14

The Effects of Grade Level, Ethnicity and Sex on Mathematics Grades

Source of Variation	Sum of Squares	DF	Mean Square	F	Signif of F
Main Effects	2.090	4	0.552	1.101	0.355
Grade	0.709	2	0.354	0.747	0.474
Ethnicity	1.363	1	1.363	2.873	0.091
Sex	0.001	1	0.001	0.003	0.958
2-Way Interactions	3.178	5	0.636	1.340	0.246
Grade Ethnicity	0.718	2	0.359	0.757	0.470
Grade Sex	2.430	2	1.215	2.561	0.078
Ethnicity Sex	0.017	1	0.017	0.035	0.851
3-Way Interactions	1.037	2	0.519	1.093	0.336
Grade Ethnicity Sex	1.037	2	0.519	1.093	0.336

Discriminant Analysis of the Mexican American Sub-Sample

Discriminant analysis is a method for statistically distinguishing between two or more groups of cases. To distinguish between the groups, the researcher selects a collection of discriminating variables that measure characteristics on which the groups are expected to differ. Discriminant analysis attempts to do this by forming one or more linear combinations of the discriminating variables. These discriminant functions are of the form

$$D_i = d_i Z_1 + di_2 Z_2 + \ldots + d_{ip} Z_p$$

where D_i is the score on the discriminant function i, the d's are weighting coefficients, and the Z's are the

standardized values of the p discriminating variables used in the analysis. The functions are formed in such a way as to maximize the separation of the groups. Since the discriminant functions can be thought of as the axes of a geometric space, they can be used to study the spatial relationships among the groups. The weighting coefficients can be interpreted as in multiple regression or factor analysis. In this respect, they serve to identify the variables which contribute most to differentiation along the respective function.

In using discriminant analysis on the Mexican American sub-sample, the objective was to determine differences between sub-groups within this sub-sample. Up to now, we have discussed only the differences between Mexican-Americans and Anglo students.

The first variable for the discriminant analysis was the degree of Spanish fluency of the respondents. The respondents were divided into two groups: Those who were fluent or very fluent in Spanish (Group 1) and those who were poor in Spanish or did not know Spanish (Group 2). Since there are two groups, there could be only one discriminant function. The mean value for Group 1 was -0.37012 and the mean value for Group 2 was +0.20368. Using the .05 level of significance, it was found that respondents in Group 1 had less positive overall attitudes toward mathematics. In addition, they felt

teachers were less supportive of their academic work. Respondents in Group 1 also felt they had less support from their parents. These results suggest that within the Mexican American sub-sample, the more assimilated respondents (as indicated by loss of Spanish language skills) may have a greater likelihood of pursuing a mathematics related career. However, additional multivariate analysis has to be conducted to confirm these suggestive findings.

A discriminant analysis using the respondents' feelings of cultural acceptance (Question 186) to classify sub-groups showed similar results. Three sub-groups based on the subjects' feelings of cultural acceptance were used in the analysis -- complete acceptance, almost complete acceptance and partial acceptance. It was found that alienation, teacher's support, locus of control, and ethnic stereotyping were all affected by degree of acceptance. That is, the respondents who perceived a higher level of cultural acceptance tended to be less alienated and less likely to be affected by ethnic stereotypes. They also tended to have more internal locus of control and felt that they had greater support from teachers for their academic work. Again, further multivariate analysis on the

sub-sample of Mexican Americans has to be conducted before we can present a more definitive profile of differences within that group.

Variables Which Influence Career Choice: A Factor Analysis

A factor analysis was conducted to determine the major factors which affect career choice. The specific procedure used was principal factoring with iterations, followed by a varimax rotation in order to simplify the factor structure. The objective of the varimax rotation is to simplify the columns of a factor matrix so that

$$n \sum_{p=1}^{m} \sum_{j=1}^{n} \left(\frac{A_{ip}}{h_j} \right)^4 - \sum_{p=1}^{m} \left(\sum_{j=1}^{n} \frac{A_{jp}}{h_j^2} \right)^2 \rightarrow \text{Maximum} .$$

Questions 6 to 19, in which the respondents were asked to rate the importance of a number of variables in choosing their career, were used in the factor analysis. Five factors were extracted. The varimax rotated factor matrix is present in Table 15 and the eigenvalues and percentage of variance explained is presented in Table 16.

Table 15

Factor Analysis of Determinants of Career Choice:
Varimax Rotated Factor Matrix

Question #	Factor 1	Factor 2	Factor 3	Factor 4	Facto
Q6	-0.00359	0.02580	0.07078	0.05418	0.64
Q7	0.15054	-0.06103	0.50291	-0.06489	0.27
Q8	-0.01630	-0.08668	0.01321	-0.10235	-0.13
Q9	0.21403	0.07079	0.10693	0.05437	0.40
Q10	0.94386	0.02424	0.04306	0.05437	0.09
Q11	0.89998	0.02461	0.03056	0.08119	0.07
Q12	0.55702	0.04385	0.15958	0.05348	0.06
Q13	0.08545	-0.14374	0.10750	-0.12388	-0.07
Q14	0.09935	0.29040	-0.02340	0.71447	0.11
Q15	0.13899	0.28566	0.02899	0.77834	0.08
Q16	0.07270	-0.03673	0.84087	0.03749	0.07
Q17	0.04116	0.00451	0.74499	-0.00951	-0.02
Q18	0.07279	0.89167	-0.02632	0.27919	0.08
Q19	0.08165	0.80659	-0.01413	0.31405	0.09

Table 16

Factor Analysis of Determinants of Career Choice:
Eigenvalues and percentage of Variance Explained

Factor	Eigenvalue	Pct of Var	Cum Pct
1	2.95553	39.7	39.7
2	2.07007	27.8	67.4
3	1.35591	18.2	85.6
4	0.57163	7.7	93.3
5	0.49982	6.7	100.0

Each of five factors has high loadings on different variables. Factor 1 had high loadings on the opinions of authority figures (Qestions 10, 11, and 12) and explained 39.7% of the common variance. Factor 2 had high loadings on the attitudes toward ethnic occupational stereotypes (Questions 18 and 19) and explained 27.8% of the common variance. Factor 3 had high loadings on the amount of mathematics, science and education needed for the job (Questions 7, 16, and 17) and explained 18.2% of the common variance. Factor 4 loaded highly on the attitudes toward sexual occupational stereotypes (Questions 14 and 15) and explained 7.7% of the common variance. Factor 5 had high loadings on attitudes toward money and status associated with a career (questions 6 and 9) and explained 6.7% of the common variance. These five factors provide a clear picture of the determinants of career choice and their relative importance among the respondents. In summary, the five determinants of career choice, as indicated by the loadings of the five factors, are, in order of importance:

1. Authority figures' attitudes toward career
2. Ethnic occupational stereotypes
3. Educational prerequisites of career
4. Sexual occupational stereotypes
5. Money/status benefits of career.

The Determinants of Mathematics Persistence: Some Preliminary Considerations

Before presenting the results of a path analysis on mathematics presistence and achievement, we will examine the relative importance of selected variables which affect persistence in mathematics. In Questions 67 to 73, the respondents were asked how important a number of variables were in deciding whether or not they would take more mathematics courses in high school than are required. The mean ranking of importance of each variable (5 = highest) is shown in Table 17.

Table 17

Mean Ranking of Importance of Selected Determinants of Mathematics Persistence

Question		Sample Mean	Rank
67	What my mother thinks	2.932	4
68	What my father thinks	2.916	5
69	What my mathemtics teacher thinks	3.140	3
70	How good or bad I am in mathemtics	3.962	2
71	How useful I think mathematics will be in getting into college	4.408	1
72	Whether my friends take mathematics	1.612	6
73	Whether my classmates approve of people who take a lot of mathematics	1.431	7

The usefulness of mathematics for college entrance and the respondents' perceptions of their aptitudes in mathematics were ranked as most important. The attitudes of the authority figures were ranked in the middle, and the attitudes of friends and classmates were least important. Thus it appears that the respondents persistence in mathematics was less influenced by significant others than by their own assessment of their ability in and their need for mathematics in order to pursue their academic goals.

In Chapter V the question of which factors are the best predictors of participation or achievement will be dealt with. The strategy and techniques used to develop a model of prediction and to gain more insight into significant factors will be discussed in detail.

CHAPTER V

Mathematics Persistence and Achievement: A Path Analysis

A path analysis on mathematics persistence and achievement was conducted. Three measures of mathematics persistence were used: the number of mathematics courses the respondents plan to take, the number of years of mathematics they plan to take, and whether they plan to take college preparatory courses in mathematics. It should be noted that, strictly speaking, these variables measure the respondents' expected persistence rather than actual persistence. One single measure of mathematics achievement was used: the respondents' grades in mathematics.

In the path model, it was hypothesized that mathematics persistence and achievement are directly affected by the respondents' score on the Group Embedded Figures Test, educational expectations and overall attitudes toward mathematics. It was also hypothesized that the following variables directly affect educational expectations and, through educational expectations, indirectly affect mathematics persistence and achievement:

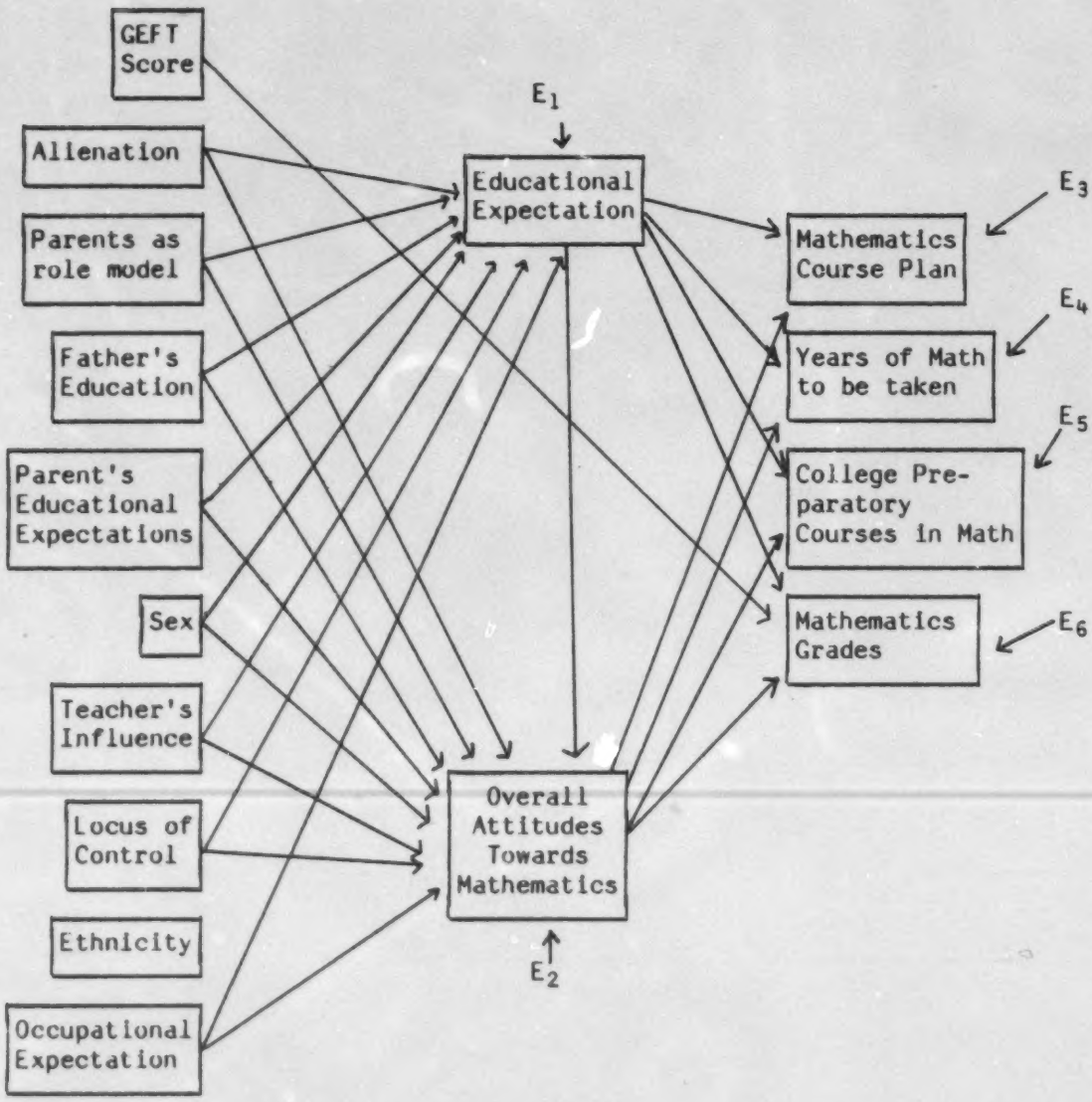
1. Score on the Group Embedded Figures Test
2. Alienation level

3. Respondents perceptions of their parents as educational role models
4. Father's education
5. Parents' educational expectations
6. Sex of respondents
7. Respondents' perception of how much they are influenced by their teachers
8. Level of locus of control
9. Ethnicity of respondents
10. Occupational expectations of respondents.

It was hypothesized further that this set of ten variables directly affect the respondents overall attitudes toward mathematics and, through that, indirectly affect mathematics persistence and achievement. Finally, it was hypothesized that there is a direct causal path from educational expectation to overall attitudes toward mathematics. The results of a test of this path model are shown in Table 18.

Table 18

A Path Analysis of Mathematics Persistence and Achievement



Using the .05 level of significance, all hypothesized paths were confirmed except the following:

1. The scores on the Group Embedded Figures Test and ethnicity (Mexican Americans versus Anglos) were not causally related to educational expectation.
2. The same two variables were not causally related to overall attitudes toward mathematics.
3. Scores on the GEFT had no causal impact on any of the three measures of mathematics persistence.

The standardized regression (i.e. path) coefficients for each set of paths are presented separately in Tables 19, 20, and 21. The path coefficients ($\sqrt{1-R^2}$) from latent variables (i.e., all residual causes) associated with X_i in which X_i is the dependent variable and all causally prior variables are used as predictors, are presented in Table 22.

Theoretically, this path model assumes that the subject's own educational expectation and overall attitudes toward mathematics plus their aptitude for mathematics as reflected in GEFT scores, are the most important factors which directly affect mathematics persistence and achievement. We assert that educational

expectation directly affects overall attitudes toward mathematics and directly affects mathematics persistence and achievement. This means that as long as the respondents have high educational expectations, whether they have positive attitudes and aptitudes toward mathematics or not, they will persist and achieve in mathematics. In this case, they recognize that mathematics is indispensable for them to carry out their educational plan, even though they may not like it or they may not be confident in it or do not have the aptitude to do well in it.

Table 19 shows that educational expectation and overall attitudes toward mathematics both have independent causal effects on each of the four measures of mathematics persistence and achievement. The causal effects of these two variables on the three persistence measures are similar, with path coefficients in the 0.2 to 0.3 range. However, overall attitudes toward mathematics strongly affected mathematics grades, while educational expectation had only a small causal effect on mathematics grades.

Table 19

Standardized Regression Ceofficients for Causal Paths With the Four Measures of Mathematics Persistence and Achievement As the Dependent Variable

Independent Variables	Dependent Variables			
	Mathematics Course Plan	Years of Mathematics	College Preparatory Courses in Mathematics	Math Grades
GEFT	N.S.	N.S.	N.S.	.12607
Educational Expectation	.21262	.27264	.30789	.06904
Overall Attitudes Toward Mathematics	.30183	.29575	.21425	.30350

Thus educational expectation had a relatively strong effect on persistence but only a small effect on achievement. On the other hand, GEFT score, as a measure of mathematics aptitude, had a causal effect on achievement but no causal effect on persistence. This suggests that as long as the subjects have high educational expectations or positive attitudes toward mathematics, they will persist in mathematics whether they have a strong aptitude in that subject or not. Mathematics acheivement, however, is affected most strongly by attitudes, secondly by aptitude and finally by educational expectations.

Turning to overall attitudes toward mathematics as the dependent variable, the results show that GEFT scores and ethnicity had no significant causal effect on this variable (see Table 20).

Table 20

Standardized Regression Coefficients for Causal Paths With Overall Attitudes Toward Mathematics as the Dependent Variable

Independent Variables	Dependent Variables: Overall Attitudes Toward Mathematics
GEFT Score	N.S.
Alienation	-0.07956
Parents as Role Models	+0.25245
Father's Education	0.09173
Parent's Educational Expectations	0.11063
Sex	0.06942
Teacher's Influence	0.30495
Locus of Control	0.06319
Ethnicity	N.S.
Occupational Expectations	0.10222
Educational Expectations	0.12782

Among the significant causal paths, teacher's contributed most to the explained variance, followed closely by parents as role models. Thus it appears that the support and influence of these three significant others--father, mother and teachers--are the most important in shaping the respondent's attitudes toward mathematics.

Three other causal variables--educational expectation, occupational expectation, and parents' educational expectation contribute moderately to the explained variance. The remaining paths, including alientation, father's education, sex and locus of control, contribute much less to the explained variance.

Looking at educational expectation as the dependent variable, it was found that GEFT scores and ethnicity had no causal effect.

Table 21

Standardized Regression Coefficients for Causal Paths With Educational Expectations as the Dependent Variable

Independent Variables	Dependent Variable: Educational Expectation
GEFT	N.S.
Alienation	-0.07718
Parents as role models	0.10340
Father's Education	0.10301
Parent's Educational Expectation	0.27557
Sex	0.06880
Teacher's Influence	0.09846
Locus of Control	0.07461
Ethnicity	N.S.
Occupational Expectation	0.29501

The respondents' occupational expectation and parents' educational expectation had, by far, the most causal

impact on the respondents' educational expectation. Variables with moderate causal impact were parents as role models, fathers' education, and teacher's influence. Variables with small (but satistically significant) causal impact included alientation, sex and locus of control.

For this study, the most important results from the test of the path model is that, when other variables are taken into account, ethnicity has no causal impact on the respondents' educational expectation and attitudes toward mathematics. The variables which seem to have the most impact on educational expectation and attitudes toward mathematics are support by authority figures (parents and teachers) and the respondents' own career expectations. It is also interesting to note that mathematics aptitude (GEFT score) seemed to have no causal effect on educational expectation, attitudes toward mathematics, or mathematics persistence, and only a moderate effect on mathematics grades. The respondents' overall attitudes toward mathematics have a strong causal impact on both persistence and achievement, while educational expectation affected primarily persistence. Finally, it should be mentioned that sex had a small causal effect on educational expectation and attitudes toward mathematics, even when other variables are taken into account.

Although path analysis is a method for testing causal models, we should be cautious in using these results because large proportions of variance in the dependent variables were left unexplained as indicated in Table 22.

Table 22

Path Coefficients from Latent Variables For the Path Model in Table 18

Dependent Variables	Path Coefficients from Latent Variables ($\sqrt{1-R^2}$)	R^2
Educational Expectation (E_1)	.80504	.35190
Overall Attitudes toward Mathematics (E_2)	.85288	.27258
Mathematics Course Plan (E_3)	.91127	.16958
Years of Mathematics to be Taken (E_4)	.89041	.20717
College Preparatory Courses in Mathematics (E_5)	.90973	.12987
Mathematics Grades (E_6)	.93280	.17239

Further theoretical and empirical analysis is yet to be done before we can arrive at a set of conceptually sound and parsimonious propositions about the determinants of mathematics persistence and achievement among Mexican American and Anglo high School students.

CHAPTER VI

The Interview Study

The purpose of this segment of the study is to explore through interviews, the math persistence of Mexican American students who are of proven high ability in mathematics. Intensive interviews make it possible to take a longitudinal look back over several generations at attitudes toward education and mathematics, level of education, cultural and familial environment, and socioeconomic status. Because parents' career histories are so much more developed than students', examining the factors that facilitated or prevented parental achievement of career goals (especially in the area of mathematics) yields an abundance of anecdotal data not obtainable from the students themselves. Therefore, much of the focus of this inquiry is on the parents' career histories and background as well as the intergenerational relationships that may now be effecting the students' own career plans and aspirations.

Since the study is primarily concerned with Mexican American or Hispanic students, all discussions will refer to this ethnic group unless otherwise indicated. White Americans of any ethnicity will be referred to as "Anglos" although they may not necessarily be of Anglo-Saxon heritage.

Methodology

In this segment of the study, 24 students of proven mathematical ability were selected to be interviewed from the original survey sample. Whenever possible, both the mother and father of the student were also interviewed. In five families, fathers were unable to be interviewed because of work commitments. An interview format was followed (See Appendix H), but the interviewer added or deleted questions if appropriate and also attempted to encourage informal contributions on the part of parents and students. In general, interviews with parents averaged an hour each. Student interviews were about half as lengthy because the adolescents were less likely than their parents to volunteer information or to give lengthy answers to questions. Most of the interviews were both individual and private, but in two cases family members were so intensely interested in the discussion that the interviewer did not ask them to leave the room. All of the interviews were done in the subjects' private homes with the subjects' consent. Most families contacted were extremely cooperative if not eager to participate in the study but several were forced to defer on the basis of other commitments and/or difficult work schedules.

The interview sample was one of convenience -- not systematically or randomly selected -- which lessens the validity of generalizations from the gathered data. However, the interviews and their anecdotal method of presentation are intended to enrich and add insight into the more representative data of the survey rather than to stand on their own as scientific "proof" of any hypotheses.

The Interview Sample

The sample consisted of 25 students of proven mathematical ability and their parents. Because one family had two students with high math ability who were selected to be interviewed, there were actually 24 families involved in the study. Only one of the mothers interviewed was a stepmother. Five fathers were not interviewed; one of these was deceased, two others were stepfathers, and two were working out-of-town when the interviews were conducted. All families were two parent families and only three families had step-parents.

Sixteen families were Mexican American or Hispanic. Of these, however, three had Anglo (white Americans of varied ethnicities) mothers. It is interesting to note that the three Anglo women were married to the Mexican American or Hispanic males with the most education and highest income. Eight of the families were Anglo.

Family income ranged from $16,000 per year to well over $50,000 per year. All families lived in either the suburbs of larger cities or in small towns, and all lived in individually owned homes except for two families who lived in military housing. Homes varied from modest dwellings in working class neighborhoods to opulent suburban homes bordering golf courses.

Of the 27 Mexican American and Hispanic mothers and fathers, nine did not finish high school; four had high school diplomas; four had high school and some college; four had college degrees, and two had master's degrees -- both in education. One Anglo parent -- a mother -- didn't finish high school; three had high school degrees; one had an associates degree; four had high school and some college; five had college degrees, and one had a PhD.

Eleven of the students were female and fourteen were male. At the time the interviews were done, the students were in grades 9 through 12, and were 15 through 17 year of age.

Students came from homes with one to eleven children. They often had siblings who were said to be good a mathematics also. In general, the students seemed to be overall high achievers with above average

grades in other subjects besides math. Many of the students were also involved in school athletics and clubs.

The majority of the students intended to take or had taken four or more years of math in high school. Several planned to take only three years of math, and only two -- both girls -- had taken or intended to take just one or two years of college preparatory math.

Nine of the 17 Mexican American students aspired to math or science related professions; of these, six were boys and three were girls. Professions chosen in math-science areas included accounting, computer programing, architecture, medicine, and biology. Professions chosen by the remainder of the students in the "non-math" related areas included writing, professional athletics, fashion designing, music, acting and law. Among the Anglo students, all but one of the males chose math-science professions while none of the females did so. Professions chosen included law, computer programing, accounting, teaching, business, and secretarial work.

All but one of the students hoped to go to college although the amount of enthusiasm and interest shown in a college education during interviews varied widely, especially from boys to girls. The more educated parents intended to pay for all or most of their child's college

education. Parents with a high school degree or less expected their children to finance a large part of their own educational expenses.

Family Environment of Interviewed Students

According to the data provided by the sample, students and their parents, the sixteen Mexican American and Hispanic families shared a number of common characteristics.

These included:

(1) Early socialization and preparation of children before entry into grade school.

(2) Tutoring and coaching of children in academic problem areas if within the parents' capabilities.

(3) Great emphasis on high school and college education by parents.

(4) Good relationships between parents and children with mothers often being the affective centers of the family.

(5) Firm (but not harsh) discipline and structure in the family.

(6) Careful monitoring of children's friends and activities by the parents.

(7) The expectation of disciplined, courteous behavior from the children.

(8) A centering of family activities around children, i.e., parental attendance at athletic and school events, coaching children in sports, or in general spending substantial amounts of time in familial activities.

(9) Church attendance and some involvement in church activities for the whole family.

(10) An effort made by the parents -- and expressed in the interviews -- to provide their children with opportunities that they -- the parents -- have never had.

In addition, parents seemed to have played a lot of games with their children, especially during early childhood. Some of the top math students had played a variety of math games with their fathers during the early childhood years. Lastly, not one parent admitted that any of their children ever committed a delinquent act or had any serious behavior problems. It's not certain whether parents were totally candid on this issue, but looked at as a group, the interviewed students did appear to be a singularly well-behaved group of youngsters.

Language Environment

Mexican American students chosen for the interview study were not bilingual in any real sense. Most of the students said that they understood some or a lot of spoken Spanish, but none of them spoke it fluently. All of the students interviewed spoke clear unaccented English. Some of the students had learned Spanish as babies along with English. Their parents reported that after starting school their facility in Spanish was lost. All of the students' parents spoke English, although only a few of the parents pronounced English as well as their children.

Parental Backgrounds: Past Barriers to Educational Attainment

Mexican American parents had amazingly homogeneous backgrounds. Almost all of the parents came from large, poor, Spanish-speaking families. Some families had been in the United States for several generations and others had emigrated more recently from Mexico. The most recent emigres among the parents came to the U.S. in their teens. In all of these Mexican American families the primary facts of life were poverty and hard work. Fathers were miners, migrant workers, or were intermittently employed at a variety of low-paying jobs. Frequently, one uncertain and meager income did not

suffice, and mothers and children had to work full-time just to help provide the family with the barest essentials of food, clothing, and shelter:

> "My dad worked for a rancher some of the time and he worked in the sawmill in the area. He did a lot of different jobs. We had animals -- cattle, rabbits, chickens, ducks .... We worked hard since we were very young. Working in the field -- the alfalfa -- bringing it in and the corn. Myself and two older sisters."

While the older children worked in the fields, the younger children learned to be self-reliant at home:

> "I was born on the corner of Dysart and Indian School. We had a little camp there, and that's where we lived. Mom worked like picking vegetables, grapes. She would come home real late. Dad was a mechanic. At a very young age we had to learn how to cook for ourselves or starve. And run the house-hold."

The hardships of poverty and inadequate medical care took their toll, especially in the lives of the children:

> "Well, you know, like in the twenties and the thirties they didn't have all the antibiotics, you know, that they have now, and they lived out -- well, that was in Texas. Out on the ranch with no facilities really. I mean you didn't go to the hospital to have a baby or you didn't see a doctor regularly at that time. So, they would catch a disease and that would be it, you know, because there would be no medication for it, and that's what happened to the babies."

Survival in a society where Mexican Americans were exploited as a plentiful source of cheap labor in the fields and mines meant that for many, obtaining a high school diploma was an impossible dream. A father who

helped older students with their math because of his own superior ability explained why he had to quit school in the seventh grade:

> "At that time it was kind of hard. Say we was a big family -- eight brothers and four sisters ... I was needed to help my family and say like I helped my brother. He lives in Tucson; he's about 2 years younger than me, so I helped him go to high school. He finished grammar school here in about three years because he was real smart, and then one of his teachers wanted to talk to my dad. So I told my dad to let him go to high school and I'd help support the family."

Poverty was not the only factor that kept parents from obtaining high school and college degrees; for some -- perhaps many -- of the parents, one of the more traumatic experiences of childhood was starting school in a strictly monolingual system:

> "I remember I used to feel that everyone was just making noises and not saying anything. Because they weren't speaking what we knew, but then we got it across that it was just another language."

Not only was this a confusing way to be introduced to the world of literacy, but children were actually punished by the teachers for speaking Spanish to each other:

> "If I would talk in Sanish the teacher got a ruler and hit me on the head and said, 'I don't want you to speak Spanish anymore.' I learned right away. We would play school and I learned pretty fast. But I got hit over the head a lot of times."

Thus, language difficulties -- that persisted for some of the parents -- and the poverty that often differentiated the Mexican American students from the white majority made it very difficult for these parents to successfully adjust to the educational system. Education became less and less a perceived option:

> "For playing with a little colored girl or because I spoke Spanish, they would make fun of me. Or even because I took a sack lunch, and they could eat in the cafeteria -- we couldn't afford it. It hurt and I didn't want to go to school. My first year I came home. I just walked home and it was far; I had to cross the tracks and everything. But I just started walking, crying. I came home."

Mexican American parents who did not finish high school often spoke of the lack of parental support for education in their childhood homes:

Indeed, for many Mexican American families a "normal life" in those times involved working terribly hard from an early age, marrying early, and raising a large family. These families -- who were really landless proletariat of Mexico and the American Southwest -- were sometimes slow to change a way of life that had been theirs for countless generations:

> "They didn't speak English or know how to read, so when we got our report cards, they didn't bother to read it or find out how we were doing in school -- nothing like that. He (father's father) didn't expect us to get that high in school or anything. Just start work when we started growing a little big. And just living a normal life. We didn't expect to get

anyplace in life, just live around the field and work. Migrants. Just grow up and get married. We didn't make much out of it; it was just the way it was. In that time we didn't think that much of education."

Parents who -- in spite of poverty, language barriers and discrimination -- finished high school and/or college remembered the emphasis put on education by their parents. These parents -- even though also poor and illiterate -- saw education as the vehicle by which their children could become upwardly mobile. There was the hope that they might be able to improve their economic status sufficiently to do more than simply survive and endure:

"My dad worked for the Southern Pacific Railroad and my mother took in ironing to help out at home. I'm the youngest of 4. My parents were both very educational minded; they were both illiterate, and the first thing was 'go to school, go to school'. All four of us graduated from high school, but two of us went on to college."

Another parent, a successful and respected administrtor, commented upon the emphasis placed upon education by his parents:

"My dad had a third grade education and my mother either had first or second. They can't read or write in either Spanish or English, but they understand both languages. They emphasized on us going to school. There are three of us; I'm the oldest and I had perfect attendance 11 out of 12 years; my sister who was next had 9 out of 12, and my brother had 10 out of 12. They believed in us getting an education because they didn't want us to be like them. They

wanted all of us to keep on going because my dad was just a hard laborer building construction. My mother was a housewife. The three of us have finished college. We managed to get through."

Career Planning

Mexican American parents told frequently of a lack of support and guidance not only from their own parents but also from teachers and counselors at school. One father discussed his youthful ambition to be an architect and how lack of adequate high school preparation effectively blocked this goal:

"I wanted to take more classes later on and go to college, but I didn't prepare myself in high school to do what I wanted to do -- be an architect. I had mechanical drawing and architectural drafting and I did very well in there. My teacher told me I had the potential to be a good architect. I was good in math and physics, but I got so screwed up in high school that I ended up taking algebra my fourth year where I should have taken it my 1st or 2nd year -- just because I didn't have someone to tell me, 'hey, this is what you need.' I didn't have guidance."

Another parent -- now a teacher -- did not recognize her own potential until after her children started school. During her high school days, no one encouraged her to go on to college:

"Like I said, I never really thought I was smart. The town where I grew up, like I said, the teachers -- they didn't know Spanish -- so they didn't think I was intelligent. So they got kids who didn't know any English; so they couldn't help them. That was a shock to me because I wanted to go to school and I went to school, and hey, there she is, the teacher, and I don't understand her. All through school,

not until I was a junior when I found out that I was nominated for the National Honor Society, did I kind of feel, 'hey, that's something good."

Far more insidious, however, if not equally harmful, was the kind of guidance and career advice given by counselors who channeled able students into vocational courses on the basis of their ethnicity. A father who is a successful engineer today recounted his long battle to prove that he could succeed in college:

> "In the junior high school and the high school system -- especially junior high -- we were given a battery of tests then, and all the tests indicated that maybe I should be anything but a college student. Be a carpenter maybe, or work on a farm, or make the military my career, but certainly college was not the way to go. I believed that orientation very early; I don't believe I was encouraged in high school to go ahead."

Like their parents, Mexican American students interviewed did not have many role models in their fields of interest or ability who were available to encourage or advise them. Unlike any of their parents, some of the students had educated parents to assist them in the development of a career plan. Students mentioned four sources of career and curriculum information: (1) parents, (2) siblings, (3) teachers and (4) counselors at school.

Mexican American parents with little education were able to give support and to stress the importance of education, but could not give specific advice about courses to their children. They left these career decisions up to the students and their counselors. When asked whether he felt that his child needed to take math courses in high school, a father commented:

> "I don't know; I can't say yes or no because I'm not too involved in math, so I don't know what kinds of jobs are out there for math or anything. Could be, but I don't know."

In contrast, educated parents seemed to be much more involved in the decision making process:

> "I'm trying to govern them; in fact, I'm pushing them. I will not force, but I will try to see that the courses they take -- actually both my wife and I have as much math -- and they will take the maximum they can in their four year curriculum."

Parents without an education made no negative remarks about the career counseling or advice that their children received at school. They seemed to be satisfied with leaving career planning up to counselors and teachers. Parents with education were not so complacent; witness the feelings of an Anglo father with some considerable knowledge in mathematics:

> "I was very astounded when we got the curriculum. We talked about it and then called the counselor to get more information because I was very concerned that we pick out the right courses and didn't miss what he needs to be taking. There was very little counseling given

to parents and children as far as I'm concerned. If your child wants to go to college, what do you prepare him for and what areas should he be really looking into? It was a big guess on my part, and I really didn't like that, so we did some digging, talking, and I hope, got him on the right curriculum. What to take for electives and so on that will be beneficial and useful. I think the parents should have some kind of coaching as to how to advise your child. I don't believe in what our grade schools are producing -- that the whole thing is the responsibility of the student."

Mexican American students -- for the most part -- appeared to have had little direct contact with school counselors. When asked questions about who had discussed their high school curriculum with them, only a few students mentioned discussions with counselors. More frequently, students said that teachers had talked about the importance of taking math in high school, but few students received specific career advice from anyone, and during interviews or afterwards, often asked where they could obtain such information. One hispanic student, a graduating senior, said, "I wish I could find out more things about math and math careers."

Despite some parents' dissatisfaction with curriculum, counseling in the school systems and the fact that some students -- minority students -- rarely see their counselors, the interview material does not prove in any way that counselors are not doing expert, competent jobs with their students; what can be suggeted,

however, is that if career counseling is inadequate in some school sytems, minority students -- who are less likely to have parents that are educated -- are going to be disadvantaged in comparison with students who come from backgrounds with more educational resources. And, able Mexican American students who are high achievers in math may be inadequately prepared in high school for the pursuit of math or math-related majors in college for lack of encouragment and information.

Impact of Role Models

Mexican American parents who had college or graduate degrees not only appeared to come from families in which the importance of education was emphasized, but also spoke of having had supportive "role models" or "mentors" during their grammar school years. These role models appeared to provide the kind of supportive guidance that channeled some students into specific career areas. Although some parents said that older siblings had played this sort of role in their lives, the most commonly mentioned role model was a teacher. A parent who is now a teacher with a graduate degree said of one of his former teachers:

> "No, the only one I remember encouraging me to keep on going and trying my best was a fourth grade teacher, a male, in New Mexico. I can look back and I always wanted to be like him ... I liked to be like him; in fact, two of my classes run like him, sort of."

Another parent--a teacher and administrator -- modeled his career after that of the coach that he had in the fourth grade:

> "I had a Mexican coach in the fourth grade when we first started our athletic program, and I helped him load and unload equipment that was left over from the white school. At that time, I decided that it was my goal, that I wanted to be a coach -- my fourth grade coach -- he's also a principal."

It seems natural that children of illiterate working class parents would model their careers after the only educated people that they have had any sustained exposure to in life, i.e., teachers. And so, those who were given the rare opportunity to break away from illiteracy and hard manual labor often became teachers. Parents and relatives could not be role models for those who went on to higher education. The children knew their teachers, but they did not know any mathematicians or scientists.

Only two of the educated Mexican American parents majored in math-related fields in college. Of these two, one was pushed to excel in math by his older brother:

> "I had an older brother who is five years older and he was good (in math). He always kind of tutored me all along so I've always liked it ... I think I had some ability, but if it hadn't been for my brother, I wouldn't have excelled in math, because I always had like a private tutor at home ..."

This same older brother encouraged this parent to remain in college when the going got rough:

> "My brother grabbed me, him and my father, and they told me I was going to finish before I did anything else. He said I don't care if you go into basket weaving, you are going to get a degree. He had a big influence; he is the one who said 'I don't care if it's in basket weaving, you are going to get a piece of paper that said you finished college.' So my brother had a bigger influence on me than my parents."

Thus, it appears that these parents were very much influenced by significant others in their lives. Their uneducted parents supported their educational goals but other educated individuals helped to determine the specific career path that was taken. Now, a generation later, the children of these parents have -- perhaps -- a few more adult role models in the family and community who have successfully made the transition from the working class to educated middle class status. However, when asked to name someone that they knew in the profession that they aspired to, most students could not. And, few of these high achievers in math knew anyone who had a career in mathematics or even in a related area. Girls, especially, lacked successful role models in any professional field. It appears that if role models are important in determining career paths of Mexican American students who are math, that few will choose or be able to choose a career in mathematics or a related area.

Attitudes Toward Math: A Means to An End

It's hardly surprising that a group of youngsters who are above-average in mathematical ability should -- for the most part -- enjoy math courses in school, make average or above grades in math and intend to take 3-4 years of math in high school. Nor can it be considered unusual that many of the students indicated that they intend to take math courses in college. What is surprising -- perhaps -- is that these students appeared to consider math as a means to an end rather than an end in itself, despite their professed enjoyment of the subject. For these students, math is the pathway to high status, high paying professions in medicine, law, and computer science. It is not something to be pursued for its own sake -- with intrinsic value. Not one student expressed any interest in becoming a mathematician or indicated any interest in theoretical math. Logically enough, parents' attitudes mirrored students' in Mexican American families as well as in Anglo families. Parents expressed the desire that their children would make good money and be happy with whatever profession they chose. An Anglo father emphasized the importance of a lucrative salary to his son:

"I try to tell him that certain fields are not as lucrative as other fields, and he's pretty much decided that he wants to be a C.P.A., which is good and if that's what he wants, fine. I think that the computer science field is a little more lucrative, but he's got an interest in it or at least playing with the computer that we've got."

In other cultures, where the status of the mathematician is high, parents might urge their children to become mathematicians. In western culture, parents generally will urge their children to enter professions which are most lucrative -- since money, rather than position, achievement, contributions, or character is associated with success and power. Math-related fields are attractive because they are the means to, at least, a measure of financial security and family survival. For Mexican Americans recently arrived from the hardship and toil of the lower working class, the message is doubly clear:

"I've tried to be a success; success is not being a failure. I guess my goal at one time was to be rich; I guess I decided not to go for that goal anymore, surviving with a little bit of savings is enough. When you don't have nothing for the first 18 years of your life, and when everyone around who is a success has money, you kind of associate money with success."

In every family interviewed, television watching provided a large portion of each evening's entertainment. The media popularizes "glamour" professions, such as acting, medicine, law, detective

work, etc. Mathematicians are not portrayed as heroes on the media, although scientists are occasionally seen as mad villains, cackling madly away in their laboratories. It seemed -- when the students were being interviewed -- that they were interested in glamour (girls) or lucrative salaries (boys).

Lack of information about careers and the kinds of abilities and talents necessary to be successful at them allow the media to fill in this information gap with typically distorted media nonsense. Children most susceptible to such distortions will be those with the fewest alternate sources of expert information.

Persistence in Mathematics

Most of the students interviewed said that they enjoyed mathematics and had taken or intended to take 3 to 5 years of math in high school in preparation for college math courses. Yet, half of the students indicated a desire to pursue professions outside of the math-science area after college. Most of these students were female. Mexican American boys appeared to be just as enthusiastic about math-science areas as Anglo boys. Mexican American students who had positive attitudes toward math and yet opted for professions in other areas said that they did so simply because -- although they enjoyed math -- they enjoyed other subjects even more:

> "Well, I like math an awful lot but I like English. I don't know ... it seems to me I like it more. I'd rather; I like to write a lot of stuff."

It was apparent that for some students, math didn't exactly have a "fun" or glamourous image. When asked why he wanted to have a career in sports rather than math or science, a ninth grader replied, "Just funner." Another male student (whose parents are both in education) told the interviewer:

> "Math hasn't sparked a very big interest. There is a computer class that I'm taking next year and I like taking those kinds of classes but I don't think of doing it as a profession. I don't think of it as a career."

This same student went on to explain his lack of knowledge of and exposure to math and science professions:

> "I think it's because I'm very narrow minded -- that I haven't seen much. I've seen computer programmers and archeologists. I suppose there is a lot more I haven't seen. What I have seen hasn't been anything special."

There were only 3 students in the group interviewed who disliked math; all of these were girls. One of these -- an Anglo girl at the top of her class -- explained her feelings about mathematics and her decision not to pursue a profession in a math-science area:

> "I don't really like it, but it's easy for me to do. I don't have to spend much time like understanding it but I really don't like it. I think it's boring ... probably because it's easy for me. I like French; it's more of a challenge ... because math is boring. When I think about science, I see someone sitting in a lab doing things and that doesn't appeal to me."

An Hispanic girl, a senior, said that she had planned on becoming an accountant, but an unfortunate experience in Algebra II made her doubt her ability to succeed in this area:

> "Algebra I, I got A's all the time; I loved it -- it was so challenging. But Algebra II, I couldn't do it; I don't know what hapened and I don't like geomtry ..."

This same student blamed her inability to succeed in algebra on her teacher:

> "My Algebra II teacher; he wasn't there when I needed it. I'd ask him, 'what's happening?', and he would tell me it was right in front of my eyes. I needed someone to guide me there, and he wasn't there."

The 3rd girl, an Anglo, told a similar tale of trauma and woe. It should be kept in mind that these 3 individuals were exceptions within the group of selected high achievers.

QUALITATIVE DIFFERENCES IN GOALS BETWEEN MEXICAN AMERICAN BOYS AND GIRLS

One of the most vivid impressions emerging from the culmulative interview data is the qualitative difference between career goals of young Mexican American males and females. Mexican American boys spoke of their carefully planned and relatively realistic career trajectories; they selected more careers in math related areas and they had more plans for achieving those careers:

"I'd like to go into politics, law ... around here I hear people gripping about the government this, the government that, so I guess I can kind of relate to the people in the area ... help them out with the government by speaking for them. If it goes according to the plan I have now, it should work ... So I'll have to get into geometry and stuff like that ... logic."

Mexican American boys felt that the only obstacle to their ambitious plans was the difficulty of obtaining sufficient financial resources for their university education. And they worried about the strain on their parents' limited budgets. Mexican American females had fewer plans for the future, were less likely to plan on going to college or into math related careers, and had some ambitions that seemed somewhat unrealistic. Careers chosen included writing, acting and fashion designing -- these careers wouldn't have appeared as unrealistic if they had been coupled with some plans for achieving them -- but this was not the case:

"I want to be in something like fashion, something like that ... like either modeling or fashion designing, something in that line ... I guess because it looks so glamorous ... If I couldn't get into that I would probably just go into insurance like my Dad, but he says women don't do that good ..."

The girls' plans were conceived with an ominous lack of regard for matching ability to career, a lack of well thought out planning, and most of all or worst of all, a certain lack of enthusiasm about a future career. Many appeared to be uncomfortable when talking about plans for

the future or college. It was almost as if -- like their mothers before them, -- these young women weren't planning seriously for a career of their own. It was sometimes hard to believe that these were students with some real ability in math. Unlike their male counterparts they appeared surprised that they had been selected for the interviews (some of their parents seemed surprised also) and appeared to doubt themselves and their abilities:

> "I used to want to be a doctor, but I don't know if I can be ... Because of all the pressure."

There was a lack of strong commitment to the future. In answer to the question, "Do you hope to go to college?" One high achieving female answered:

> "Yes, that is why I'd like to go to college (something to do) but if I get married before that and have kids, I don't think that I'll go."

Another young woman wanted to be an actress -- but had never attempted acting. Failing this she wanted to be a lawyer:

> "I don't know ... I'm thinking about being a lawyer, but I don't want to study."

Male students talked about going to elite schools females spoke of community colleges or maybe, a state school. Females seemed apathetic about their studies. They lacked the air of enthusiasm generated by a number

of the male students even though their grade point averages were very high. Parents also seemed to be less excited about their daughter's plans for the future than their son's. A number of times the word "lazy" was used by parents when describing their daughters -- this word was never used by any parent in all of the interviews wher speaking of sons.

Outside of one or two more impressive, determined young women, it was easy to visualize these students in the future taking their place in society as consumers when married to middle class men, and as workworn secretaries and clerks when married to lower socioeconomic status males, or worse yet, impoverished single parents raising children on the low sarlaries that distinguish womens' professions from mens'. It is tempting to predict that very few will go into mathematics or related areas. It is among the female students that many potentially high achieving minorities capable of pursuing mathematics in college may be lost.

CONCLUSIONS

Mexican American parents interviewed discussed with the interviewer factors that hindered or prevented the attainment of their educational and/or career goals. These factors included:

(1) Poverty

(2) Lack of enocuragement and guidance from parents or other relatives

(3) Lack of encouragement and guidance from counseiors or teachers and tracking of able Mexican American students into vocational studies instead of college preparatory course

(4) Problems with the English language in school and resultant poor grades and/or poor attitudes toward school.

A number of the parents said that they enjoyed mathematics in school and had some ability in this area. In general, the impression gained from the interviews with parents was that language and cultural variables did not adversely affect math achievement. In fact, for some Mexican American parents math was easier to relate to than other courses, because performance and grades depended less on knowledge of English grammar and vocabulary. Why then did these parents not pursue careers in math-science areas? There could be a variety of logical reasons suggested by the interview data:

(1) Educational attainment was low overall because of the low socioeconomic status of the parents' families

(2) Role models in the math-science areas were few and far between -- parents often went into education because they were sometimes able to pattern their careers after their teachers

(3) Many careers in math or science require advanced degrees; it was extremely difficult for some of the parents to get an undergraduate degree because of the financial factors involved.

The students themselves were extremely optimistic about attaining their educational and career goals. They were all quite fluent in English and seemingly well-adjusted to the majority culture. Most did not believe that discrimination would hinder them in any way. Some -- especially those from the families with lower incomes -- did worry about financing their educations. Girls in general had lower, less realistic aspirations, and less confidence in their ability to achieve their goals. They were less interested in careers in math-science areas than boys.

For these students, who are special because they perform at above average levels in mathematics, it appears that the primary factors mitigating against math-science persistence and careers are:

(1) Lack of information about math-science careers

(2) Lack of the financial resources necessary for an advanced degree

(3) Sex (if female)

These -- except for sex -- are problems of socioconomic class not ethnicity. After interviewing these bright and ambitious children, it is hard to believe that there is anything specifically Mexican American that deters students from math-science careers. In fact, Mexican American boys interviewed seemed far more similar in level of aspiration, confidence, interest in math-science areas, and enthusiasm about career goals, to Anglo boys than they seemed to Mexican American girls. The main difference seen here is that the average Anglo male student will have a far easier time financing his education than the average Mexican American.

CHAPTER VII

Summary and Conclusions

The purpose of this study was to identify factors which influence mathematics participation of Mexican American students and to determine the degree of importance of each factor. Those objectives were accomplished. Additionally, in-depth interviews were conducted with selected students and their parents to further probe possible areas of importance. Through the collection and analysis of massive amounts of reliable data, possible intervention strategies and areas for future research were identified. In this chapter, these results and suggestions will be summarized.

Achievement

All students in the sample were of high ability by selection. Only students in the top three stanines on the CAT were eligible for participation. At least 50% of the sample had a B average in all their math courses and over 40% had an A average. The achievement data from this study indicates that ethnicity had no effect on student achievement. Achievement was found to be most strongly affected by overall attitudes toward mathematics, secondly by cognitive style (GEFT) and lastly by educational expectations. It should be noted that although sex had a <u>small</u> causal effect on both overall attitudes and educational expectations, the sex

differences in achievement found in earlier studies was not supported here.

Persistence

Respondents' educational expectations and overall attitudes toward mathematics both had independent causal effects on each of the three measures of mathematics persistence. Their cognitive styles, however, had no effect on persistence. This implies that students will continue to take mathematics courses as long as they have either high educational expectations or a positive attitude toward mathematics. The fact that they are field independent or field dependent has no bearing on the number of math courses they plan to take. A student's overall attitude toward mathematics more strongly influences the number of high school math courses planned while educational expectatons more strongly influence choosing the college preparatory track in mathematics.

It is of significance to this study that once again ethnicity had no effect on mathematics persistence. The analysis of variance tests, however, show that grade level and sex do have an effect. The results indicate that as a student progresses through the grades the more math courses are planned. This implies an increase in knowledge or awareness of the need for higher mathematics and perhaps an increase in self-confidence.

Additionally, it was found that sex had an effect on the number of years of mathematics the respondent planned to take. Girls always planned to take fewer than boys. This is especially interesting given the fact that sex differences in achievement did not exist. This suggests that given the same ability as boys, girls still tend to avoid the pursuit of higher mathematics in high school. Girls begin high school with the same overall attitude toward math as boys but with a higher level of educational expectation. However, as they progress through the grades, girls lower their educational expectation level while boys raise theirs. Likewise, males develop a progressively more positive attitude toward mathematics but the reverse is true for females. In terms of intervention, the strategy should be to keep both sexes progressing with positive attitudes and expectations.

Overall attitudes, Educational Expectations and Persistence

Results gained from both the analysis of variance tests and the path analysis indicate that certain categories of intervenable variables have an effect on the pursuit of mathematics courses. The two groups for this study that have causal effects are educational expectations and overall attitudes toward mathematics. These two categories are directly effected by other variables.

Overall Attitudes Toward Mathematics and Participation

The overall attitudes toward mathematics scale was constructed by combining four indexes: importance of mathematics, confidence in mathematics, enjoyment of mathematics and mathematics anxiety. It should be interpreted as a scale identifying positive attitudes and feelings about mathematics. For Mexican Americans and Anglos in all three grade levels, this was the best predictor of number of courses and number of years of planned mathematics participation.

In analyzing the variables that most directly affected overall attitudes, it can be seen that teachers influence followed closely by father and mother as educational role models contributed most to the explained variance. It appears, that these three significant others are most important in shaping the students' attitudes toward mathematics. A matter of importance here is that from the analysis of vriance tests, it was found that Mexican Americans as a group felt their parents were less supportive as educational role models. At the same time, these students were found to be more affected by authority figures in career selection than their Anglo counterparts. This suggests that even though controlling for other variables in the path model, ethnicity did not effect overall attitudes toward

mathematics, some Mexican American students feel they are lacking in positive educational support from their parents. Additionally, Mexican American students respond more positively to authority figures (teachers and parents).

An intervention strategy suggested by these results is to make teachers aware of their number one spot in influencing the attitudes and careers of all students especially Mexican Americans and develop programs to maximize the potential of this influence. Further, parent education programs aimed at raising the career and educational awareness level of all parents, especially those of high ability Mexican American students should be developed and implemented.

Educational expectation, occupational expectation, and parents' educational expectation are three moderately causal variables in predicting overall attitudes in mathematics. Educational expectation was effected by grade level and ethnicity on the analysis of variance tests. It appears as though the higher a student progresses in the grades the higher his educational expectation becomes. In terms of educational goals, it appears as though Mexican Americans had somewhat lower expectations. As pointed out earlier, ethnicity when controlled for other factors was not a significant predictor of math persistence.

Parents' educational expectations also was effected by grade level. The further the students progressed in school the further the parents' expected them to go. This coincides with the students' expectations for themselves and is a logical result. Intervention strategies for these three categories can be combined into one task of causing students along with their parents to set high but realistic educational and occuptional goals early in the students academic career.

Educational Expectations and Participation

Educational expectation was most strongly predicted by occupational expectation and parents' educational expectation. Cognitive style and ethnicity had no causal effect. It appears as though the parental influence in terms of years of education the child is expected to complete is of immense importance in a child's persistence of mathematics.

Parents as role models and teachers' influence also appears as moderate contributors to student decisions to pursue mathematics. Again, authority figures seem to be key factors in this study whereas friends and classmates seem to have little influence. Students' assessment of their own ability in and need for mathematics in the pursuit of an expected goal seems to be of primary importance.

A career awareness programs at the junior and senior high level is of utmost importance in raising the career and educational awareness of both Mexican American and Anglos. The once a year career day is not meeting the needs of students. Such a program needs to be developed and implemented through the classroom teachers since they are the most influential authority figure for the masses of students regardless of ethnicity. Students need to know early on that three or four years of mathematics are required for many majors in college. Of equal importance is the disseminating of this requirement to the parents of these high ability students. This is imperative since it seems clear that students' educational and occupational aspirations are a reflection of parents' aspirations for them.

Some intervention programs similar to the one suggested here are well underway for girls in mathematics. Their goal is to widen options and increase career awareness through workshops, classroom activities, etc. All these existing programs are fine but we are still losing many capable males and Mexican Americans who could surely benefit from similar programs. Teacher and classroom benefits are important but these programs must be extended to all students and specifically designed to include parents. Parents <u>don't</u> need to be experts in

mathematics for their children to take it in school. They do need to stress the importance of mathematics and help their children set early educational and occupational goals.

Future Research

Results from this large-scale study have helped identify areas for future in depth research. The discriminant analysis of the Mexican American sub-sample is one example. Analyzing the Mexican Americans only, it was suggested that the more assimilated the students were (as indicated by loss of Spanish language skills) the more likely they are to pursue math related careers. Further results implied that students' feeling more culturally accepted felt less alientated and stereotyped. They also felt greater support from teachers. All these ideas suggest that the more culturally "Americanized" students are the more likely they are to pursue careers in mathematics. This theory is obviously one of controversy that needs further exploration. It needs to be reinforced here that although these subgroup differences did occur, when other variables were controlled for in the path model, ethnicity did not have a causal effect on either achievement or persistence.

Another area of research continues to be that of sex. Earlier theories of participation predicting achievement were not supported here. What did occur was that, given the ability and the achievement level girls still choose to take fewer math courses than boys. Other factors are affecting female participation of any ethnicity and these need to be dealt with further.

Additionally, the path analysis used in this study with the selected variables explains a large part of the variance but a much larger part is left undiscovered. This study needs to be extended in terms of eliminating non predictive variables and continuing the search to explain 100% of the factors causing able students to avoid mathematics.

Finally, any plan or program for beginning intervention strategies suggested from the results mentioned in the study carries with it the responsibility for research and evaluation of its effectiveness. Successful intervention techniques are the key to solving the problem of mathematics avoidance.

Conclusions

The factors affecting mathematics participation of highly able Mexican American students are numerous and complex. They are, however, the same as those affecting mathematics participation of highly able Anglo students.

This finding is based on the results of a path analysis model and is certainly a surprising one.

Although most factors affecting participation were the same for Mexican Americans and Anglos, some differences did occur for males and females. Neither ethnicity nor sex issues relating to mathematics participation are ready to be forgotten. The need for continuous research is greater now than ever before as our enrollment in math and science continues to drop.

Participation in mathematics is primarily an issue of attitudes and expectations. Parent and teachers are the key factors in determining the attitudes, educational and occupational goals of the student. Awareness on the part of these influential authority figures about the need for setting early eduational and occupational goals as well as the need for mathematics to meet these goals will provide the vehicle for channeling these highly able students into scientific fields of study regardless of sex or ethnicity.

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APPENDIX A

Definition of Variables

This appendix gives conceptual definitions and detailed descriptions of scales and individual items used in this study.

I. Aspirations

A. Occupational Aspiration

The level of achievement to which an individual aspires within a continuum of difficulty is called his level of aspiration. In this study, the level of occupational prestige to which an individual aspires is considered his level of occupational aspiration (LOA). This variable seems to be an important link in the chain of factors leading to course-taking decisions and achievement motivation. For Anglos and Mexican Americans, occupational aspiration should relate to perceived usefulness of mathematics for a career or for the academic preparation required for a career.

Level of occupational aspiration was measured in this research with an adaptation of the Occupation Aspiration Scale (Haller and Miller, 1963). This scale assumes that LOA includes both realistic (best job you can get) and idealistic (job you would most like to have), short range (after your schooling) and long range (when you are thirty) dimensions. The four item test measures each dimension and the score represents a composite of all dimensions.

One additional question asks students to specifically describe the occupation they would like to have as their life's work.

B. Factors Influencing Career Choice

The respondents are asked to indicate how important each of fourteen factors will be in making their career choices. This set of items is intended to directly determine the relative importance of many of the factors which the rest of the survey questions address individually (e.g., mother, father, teacher, amount of mathematics needed, etc.).

C. Mathematics and Science Preparation Required for Job

Although occupational aspirations should logically relate to mathematics and science course-taking, a more directly related variable would be the student's perception (accurate or not) of the amount of mathematics and science required for his or her chosen career. Accordingly, a single item measures each of these variables by asking the respondents how much mathematics and how much science is needed to get into their chosen careers.

D. Educational Aspirations

In this study, the number of years of education to which an individual aspires is considered his level of educational aspiration (LEA). Educational aspirations seem to be a factor tied to course-taking and achievement as well as to occupational aspirations. We wish to explore the relationship between occupational and educational aspirations as associated with persistence in mathematics course-taking.

E. Factors Influencing Educational Plans

The respondents are asked to indicate how important each of six factors will be in making the decision to go to college. These items are intended to directly measure the relative importance of many of the factors the rest of the survey addresses individually. One additional item asks respondents to give the three important factors leading to a decision not to go to college.

II. Attitudes Toward School

A. Usefulness of Mathematics to the Individual

The research literature suggests that there are possible differences between ethnic groups with respect to the perceived usefulness of mathematics, and this variable may be related to course-taking. Items in this scale address two components of usefulness: 1) usefulness in daily life, and 2) usefulness to career and educational plans.

B. Mathematics and Oneself

Armstrong (1979) found that within the Mathematics and Oneself category three independent factors were highly correlated with participation--confidence, anxiety and enjoyment. As a result, this study does not include the typical affective category of motivation. She determined that enjoyment and participation were both measures of motivation.

1. Confidence in mathematics

Items in this scale measure students perceptions of how confident they are in mathematics and whether they have the potential to be good in mathematics.

2. Anxiety in mathematics

Items in this scale deal with students' feelings in doing mathematics and with feelings toward mathematics in general.

In order to differentiate between students whose anxiety is mathematics-specific, similar scales have been developed for Anxiety in School, Anxiety in English, and Anxiety in Science.

3. Enjoyment of mathematics

This scale includes items on students' enjoyment of mathematics, doing mathematics and attending mathematics classes.

C. Mathematics as an Anglo Domain

Although this variable may be a component of general ethnic stereotyping, it is mathematics specific and treated as a separate variable in this study. Being "mathematics-specific," this variable could have a more "direct" influence than general ethnic stereotyping on Mexican American course-taking and achievement. Significant others investigated in this study (parents, teachers, peers and siblings) could have a large influence on a student's stereotyping of mathematics or general ethnic stereotyping. Likert-type items in this scale measure the extent to which respondents regard mathematics as more appropriate for Anglos than for Mexican Americans and deal with the following topics.

1) The relative natural abilities of Anglos and Mexican Americans in doing mathematics and in careers using mathematics.

2) The relative needs of Anglos and Mexican Americans for a knowledge of mathematics.

D. Factors Influencing the Decision to Take More Mathematics

Respondents are asked to indicate how important each of seven factors will be in making decisions about taking additional mathematics courses. These items are intended to directly measure the relative importance of other factors which the rest of the survey addresses.

III. Related Facts

A. Taking more Mathematics (Intended Participation)

Two items ask respondents how many years of mathematics and science they plan to take in high school. Course names were not used in these items because many students would not know what they meant.

For correlations of participation and other study variables, intended participation was divided into five groups, none, 1 year, 2 years, 3 years and 4 years.

B. Family Status

One might expect different patterns of parental influence to be reflected in survey results for students from non-standard family situations. So that family status can be considered, a question has been included in the survey which determines whether a student lives with both parents (or guardians), just one parent, or some combination of step-parents. A second question asks students who live with only one parent if they see the other parent often, indicating an opportunity for influence.

C. Parents Education

Nine categories were used to determine parents completed educational level. Separate items were used for mother and father.

D. Parents Occupation

Nine occupational categories were used to determine parents occupations. Separate items were used for mother and father.

E. Mathematics Participation (Course-Taking)

A series of questions determines which mathematics courses respondents have taken or are taking.

For purposes of analysis, participation was defined as having three levels. In the lowest participation group, students had completed a mathematics course in general mathematics, consumer and/or business math. In the second group, students completed Algebra I. Students categorized in the third participation group completed Algebra II or Geometry.

A single item asks students if they took (or intended to take) algebra which in eighth grade.
A second series of questions determine which mathematics courses respondents plan to take in high school. This serves as a second source of intended participation data.

F. Socioeconomic Status (SES)

SES is a composite measure of the sum of items in the home, parents education, and parents occupation.

G. Grades in Mathematics

A single item asks students to indicate which of five categories best describes their grades in mathematics.

H. Type of School Program

Respondents are asked whether the emphasis of their high school courses in general, vocational or college preparatory. Additionally, respondents are asked whether they plan to take college preparatory math classes and to explain in detail their reasons.

IV. Parental Influences

Research indicates that parents can affect a student's course-taking, achievement in mathematics and career aspirations through modeling, overt encouragement and attitudes toward mathematics. Items in this category

measure the students' perceptions of parents attitudes, abilities and behaviors. Two separate but parallel scales pertain to mothers and fathers. These items are intended to determine which, if any, parental influences seem to be important.

A. Parents as Role Models

The three items in these two scales deal with mothers' and fathers' attitude toward, abilities in, and use of mathematics. They represent the students' perceptions of the examples set by parents. One additional question asks who uses more mathematics.

B. Parents' Encouragement in Mathematics

Parallel scales measure students' perceptions regarding overt encouragement given them by their parents (individually) and their parents' feelings about the students as learners of mathematics. This scale attempts to measure the influence of "active" encouragement as opposed to the passive influence of role modeling.

C. Parents' Stereotyping of Mathematics

Two single items determine whether or not students believe their parents think mathematics is "more for Anglos than for Mexican Americans."

D. Parents Helping with Homework

One item is used to determine which parents helps the student (if at all) with mathematics homework.

E. Parents' Educational Expectations for Offspring

Two items ask the students to indicate the highest level of education each parent expects them to complete. The levels of education from which the students are asked to choose are identical to those in the item measuring the students' own educational aspirations.

F. Sibling Role Models

Two items determine the status of older brothers or sisters and their ability in mathematics.

V. Influence of Significant Others

A. Peer Influence

The lower participation of Mexican Americans like other minorities in mathematics is sometimes attributed to the desire for social acceptance. Do students feel that being good in mathematics has a negative effect on relationships with peers? These items deal with what one's friends think about people who are good in mathematics or tries to avoid success in mathematics totally.

B. Peer Stereotyping of Mathematics
This scale parallels two items described in the parents' section. Students are asked whether the boys and girls among their friends think mathematics is more for Anglos than for Mexican Americans.

C. Teacher Encouragement in Mathematics
This scale deals with students feelings regarding direct encouragement given them by their teachers and teachers' attitudes of the students as learners of mathematics. Some of these items parallel those in other categories.

D. Teacher Stereotyping of Mathematics
This item deals with the respondent's perception of mathematics teachers' attitudes and whether mathematics teachers think mathematics is more for Anglos than for Mexican Americans.

E. Teacher Differential Treatment
Research has found that teachers behave differently toward Anglo students than toward Mexican American students. Various types of differential expectations, encouragement, or perpetuation of Anglo versus Mexican American behaviors may be detrimental to the achievement, self-concept, and future mathematics persistence of students of either ethnicity.

F. Counselor Encouragement to Take More Mathematics
This item measures the extent to which a school counselor has encouraged or discouraged the student to take more mathematics. The frequency and type of counseling will be noted as part of this question.

VI. Self-Descriptors

A. Locus of Control

Research suggests that high internal locus of control is associated with achievement, higher occupational level and striving self-motivated behavior. Eight items are used to measure locus of control. High scores indicate an external orientation.

B. Language Environment

The individual's language environment is defined in terms of three variables; language background, language experience and perceived effects of a Spanish accent. The first variable investigates the language development and usage--preschool and now. The second variables determines the frequency of encounters with written or spoken Spanish. The third variable assesses the student's perception of a Spanish accent in relation to achievement in school.

C. Alienation

It seems likely that students who feel "apart from society" or have a low degree of commitment to the predominant culture would not perceive mathematics as being very useful in their adult lives. We wish to explore the relationship between alienation and persistence in mathematics.

The idea of alienation as powerlessness is the most frequent usage in current literature. This variant of alienation is conceived as the "expectancy or probability held by the individual that his/her own behavior cannot determine the occurence of the outcomes or reinforcements sought." This scale places the students on a generalized alienation (powerlessness) continuum with respect to their personal attitudes from a social-psychological point of view. (Seeman, 1959, pg. 25, 26).

D. Value Orientation

Value orientations are complex but definitely patterned principles, resulting from the interplay of the cognitive, the affective, and the directive elements of a person's being. An individual's value orientation gives order and direction to the ever-flowing stream of human acts, decisions and thought as he/she relates to the solution of common human

problems. These items explore the relationship between value orientation and decisions to persist in mathematics.

Two situational questions investigate the student's value orientation toward

(1) man-nature problems:

a. subjugation to nature
b. harmony with nature
c. mastery over nature

(2) time orientation problems:

a. past
b. present
c. future

Each item represents a familiar type of life situation. A student's choice indicates which of the three variations for each orientation closely describes himself.

E. Acculturation

Acculturation as defined by Gordon (1964) is "the phenomenon which results when groups of individuals having different cultures come into continuous first-hand contact, with subsequent changes in the original cultural patterns of either or both groups." This definition suggests that in relation to Mexican American students the following continuum exists:

1. predominately Mexican oriented,

2. functional in both cultures but more comfort and participation in Mexican culture,

3. bicultural--equally functional in both cultures,

4. functional in both cultures but more comfort and participation in Anglo culture,

5. predominately Anglo oriented.

Carter (1970) suggests that the American classroom is generally structured to fit the needs of the middle-class Anglo student. This implies that academically successful Mexican American students possess the

ability and desire to participate in the system as it exists and are therefore totally acculturated into the Anglo society. It is important, however, to understand that the possibility exists for functioning effectively in both cultural worlds and thus maintain a bicultural identity (Ramirez, 1974). The questions in this scale explore the degree of student acculturation. The findings will be used to investigate relationships between acculturation and decisions to persist in mathematics.

F. Cognitive Style

The word cognition means thinking or knowing. Cognitive Style is used to express the idea that people think and process information in different ways. The emphasis is on the way of perceiving the environment and organizing information about it. In this study, cognitive style is concerned with the importance people attach to parts of the background (field) or the whole background. Some people have a style of perceiving the world in such a way that the smallest details almost always stand out (field-independent). Others overlook the small details, seeing instead the "whole picutre" (field-dependent) or overall context (Ramirez, et al., 1974).

The field-independent mode of perceiving is typical of students who are academically successful in mathematics. This fact is particularly significant given that Mexican American students are generally thought to be field-dependent (Ramirez and Castaneda, 1974). This Group Embedded Figures Test is used to determine cognitive style of subjects.

APPENDIX B

Survey Items

I.A. Occupational Aspirations

This set of questions concerns your interest in different kinds of jobs. There are four questions. Each one asks you to choose one job out of seven presented. Read each question carefully. They are all different. (1-4)

1. Of the 7 groups of jobs listed in this question, circle the BEST ONE you are REALLY SURE YOU CAN GET when your SCHOOLING IS OVER? (Circle only one group.) (1)

   1 LABORERS--such as a factory worker, custodian, warehouse worker

   2 SERVICE WORKERS--such as a housekeeper, barber, cook, waiter

   3 PROFESSIONAL--such as an accountant, lawyer, doctor, engineer, etc.

   4 MANAGER OR OFFICAL--such as a postmaster, banker, retail buyer, construction superintendent, etc.

   5 OPERATORS--such as a bus driver, truck driver, deliveryman

   6 CRAFTSMAN, FOREMAN--such as a baker, carpenter, electrician, jeweler

   7 CLERICAL, SALES--such as a bookkeeper, secretary, ticket agent, salesman

2. Of the 7 groups of jobs listed in this question, circle the ONE you would choose if you were FREE TO CHOOSE ANY of them you wished when your SCHOOLING IS OVER? (Circle only one group.) (2)

   1 LABORERS--such as a factory worker, custodian, warehouse worker

   2 SERVICE WORKERS--such as a housekeeper, barber, cook, waiter

   3 PROFESSIONAL--such as an accountant, lawyer, doctor, engineer, etc.

   4 MANAGER OR OFFICIAL--such as a postmaster, banker, retail buyer, construction superintendent, etc.

5 OPERATORS--such as a bus driver, truck driver, deliveryman

6 CRAFTSMAN, FOREMAN--such as a baker, carpenter, electrician, jeweler

7 CLERICAL, SALES--such as a bookkeeper, secretary, ticket agent, salesman

3. Of the 7 groups of jobs listed in this question, circle the BEST ONE YOU ARE REALLY SURE YOU CAN HAVE by the time you are 30 YEARS OLD? (Circle only one group.) (3)

1 LABORERS--such as a factory worker, custodian, warehouse worker

2 SERVICE WORKERS--such as a housekeeper, barber, cook, waiter

3 PROFESSIONAL--such as an accountant, lawyer, doctor, engineer, etc.

4 MANAGER OR OFFICIAL--such as a postmaster, banker, retail buyer, construction superintendent, etc.

5 OPERATORS--such as a bus driver, truck driver, deliveryman

6 CRAFTSMAN, FOREMAN--such as a baker, carpenter, electrician, jeweler

7 CLERICAL, SALES--such as a bookkeeper, secretary, ticket agent, salesman

4. Of the 7 groups of jobs listed in this question, circle the ONE you would choose to have when you are 30 YEARS OLD, if you were FREE TO HAVE ANY of them you wished. (Circle only one group.) (4)

1 LABORERS--such as a factory worker, custodian, warehouse worker

2 SERVICE WORKERS--such as a housekeeper, barber, cook, waiter

3 PROFESSIONAL--such as an accountant, lawyer, doctor, engineer, etc.

4 MANAGER OR OFFICIAL--such as a postmaster, banker, retail buyer, construction superintendent, etc.

5 OPERATORS--such as a bus driver, truck driver, deliveryman

6 CRAFTSMAN, FOREMAN--such as a baker, carpenter, electrician, jeweler

7 CLERICAL, SALES--such as a bookkeeper, secretary, ticket agent, salesman

5. What occupation would you most like to make your life's work--the work you are likely to be doing throughout your career? (Describe the occupation below; please be as specific as you can. (5)

I.B. Factors Influencing Career Choice

The following statements present facts that people consider when they choose a career. How important do you believe these factors will be in choosing your career? The answer choices are; "Not Important at All," "Not Important," "Undecided," "Important," and "Very Important." (6-19)

		NOT IMPT AT ALL	NOT IMPT	UNDEC	IMPT	VERY IMPT
1.	Amount of money I can make.	1	2	3	4	5
2.	Amount of education needed for the job.	1	2	3	4	5
3.	Whether I would enjoy the job.	1	2	3	4	5
4.	Whether it has high status.	1	2	3	4	5
5.	What my mother thinks.	1	2	3	4	5
6.	What my father thinks.	1	2	3	4	5
7.	What my teachers think.	1	2	3	4	5
8.	Whether I could do the job well (ability).	1	2	3	4	5
9.	Whether the job is done traditionally by men only.	1	2	3	4	5
10.	Whether the job is done traditionally by women only.	1	2	3	4	5
11.	Amount of mathematics needed for the job.	1	2	3	4	5
12.	Amount of science needed for the job.	1	2	3	4	5
13.	Whether the job is done traditionally by Anglos only.	1	2	3	4	5
14.	Whether the job is done traditionally by Mexican Americans only.	1	2	3	4	5

I.C. Mathematics and Science Preparation Required for Job

1. How much mathematics do you think is needed to get into the career you have chosen? (20)

   1 None
   2 Some high school math
   3 Four years of high school math
   4 Some college mathematics
   5 A lot of college mathematics

2. How much science do you think is needed to get into the career you have chosen? (21)

   1 None
   2 Some high school math
   3 Four years of high school math
   4 Some college mathematics
   5 A lot of college mathematics

I.D. Educational Aspirations

1. Supposing you had the necessary abilities, money, grades, etc., how far would you really <u>like</u> to go in school?

   1 Quit school
   2 Finish high school
   3 Go to a trade, vocational, or technical school
   4 Go to a two-year college
   5 Go to a college or university (one that grants a bachelor degree)
   6 Go to a graduate or professional school after college

2. Considering your abilities, grades, financial resources, etc., how far do you actually expect to go in school? (23)

1 Quit School
2 Finish high school
3 Go to a trade, vocational, or technical school
4 Go to a two-year college
5 Go to a college or university (one that grants a bachelor degree)
6 Go to a graduate or professional school after college

I.E. Factors Influencing Educational Plans

How important will each of the following factors be in deciding to go to college? The answer choices are "Not Important at All," "Not Important," "Undecided," "Important," and "Very Important."

		NOT IMPT AT ALL	NOT IMPT	UNDEC	IMPT	VERY IMPT
1.	Whether my high school grades are good enough.	1	2	3	4	5
2.	What my mother thinks.	1	2	3	4	5
3.	Whether my friends are going to college.	1	2	3	4	5
4.	Availability of financial aid.	1	2	3	4	5
5.	What my father thinks.	1	2	3	4	5
6.	What my teachers think.	1	2	3	4	5

7. DO NOT ANSWER IF YOU ARE PLANNING TO GO TO COLLEGE. If at present you have decided not to go to college, please list the three factors which most influenced your decision. List in order of importance. (30)

II.A. Usefulness of Mathematics to the Individual

Some people feel that mathematics is an important subject. Some people feel that mathematics is not important. How do you feel about these statements? The choices are "Strongly Disagree," "Disagree," "Undecided," "Agree," and "Strongly Agree." (31-36)

	STR DSAGR	DSAGR	UNDEC	AGR	STR AGR
1. Mathematics is a worthwhile and necessary subject.	1	2	3	4	5
2. Taking mathematics is a waste of time for me.	1	2	3	4	5
3. I probably will not need mathematics in my future work.	1	2	3	4	5
4. Mathematics is important to my future educational plans.	1	2	3	4	5
5. Knowing mathematics will help me get a good job.	1	2	3	4	5
6. Mathematics will not be very useful to me outside of school.	1	2	3	4	5

II.B.1. Confidence in Mathematics

For each statement in this section choose the one response that best describes how you feel about the statement. There are no right or wrong answers. The choices are "Strongly Disagree," "Disagree," "Undecided," "Agree," and "Strongly Agree." (37-42)

	STR DSAGR	DSAGR	UNDEC	AGR	STR AGR
1. Generally I have felt secure about attempting mathematics.	1	2	3	4	5
2. I am sure that I can learn mathematics.	1	2	3	4	5
3. I think I could handle more difficult mathematics.	1	2	3	4	5
4. I'm not the type to do well in math.	1	2	3	4	5
5. I'm no good in math.	1	2	3	4	5
6. For some reason, even though I study, math seems usually hard for me.	1	2	3	4	5

II.B.2. Anxiety in Mathematics

		STR DSAGR	DSAGR	UNDEC	AGR	STR AGR
1.	It wouldn't bother me at all to take more mathematics. (43)	1	2	3	4	5
2.	I dread mathematics class. (44)	1	2	3	4	5
3.	I don't worry about being able to solve mathematics problems. (45)	1	2	3	4	5
4.	I am usually at ease in mathematics class. (46)	1	2	3	4	5
5.	Mathematics usually makes me feel uncomfortable and nervous. (47)	1	2	3	4	5
6.	My mind goes blank and I am unable to think clearly when working mathematics problems. (48)	1	2	3	4	5
7.	School does not scare me at all. (49)	1	2	3	4	5
8.	I dread going to school. (50)	1	2	3	4	5
9.	I am usually at ease in English class. (51)	1	2	3	4	5
10.	English assignment are usually frustrating. (52)	1	2	3	4	5
11.	I don't worry about doing English assignments. (53)	1	2	3	4	5
12.	I dread English class. (54)	1	2	3	4	5
13.	I am usually at ease in science class. (55)	1	2	3	4	5
14.	Science assignments are usually frustrating. (56)	1	2	3	4	5
15.	I don't worry about doing science assignments. (57)	1	2	3	4	5
16.	I dread science class. (58)	1	2	3	4	5

II.B.3 Enjoyment of Mathematics

	STR DSAGR	DSAGR	UNDEC	AGR	STR AGR
1. Working with number is fun. (59)	1	2	3	4	5
2. I do not enjoy mathematics classes. (60)	1	2	3	4	5
3. Solving a hard mathematics problem is exciting. (61)	1	2	3	4	5
4. I do not enjoy working mathematics problems. (62)	1	2	3	4	5

II.C. Mathematics as an Anglo Domain

Some people feel Mexican Americans do just as well as Anglos at jobs that require mathematics. On the other hand, some people feel that Mexican Americans do not do as well as Anglos at jobs that require mathematics. For each statement, choose the one response that best describes how you feel about the statement. The choices are "Strongly Disagree," "Disagree," "Undecided," "Agree," and "Strongly Agree." (63-66)

	STR DSAGR	DSAGR	UNDEC	AGR	STR AGR
1. Mexican Americans need mathematics just as much as Anglos.	1	2	3	4	5
2. Mexican Americans do not need as much mathematics as Anglos.	1	2	3	4	5
3. Mexican Americans do as well as Anglos in jobs that use a lot of mathematics.	1	2	3	4	5
4. Anglos are naturally more able than Mexican Americans in scientific and technical fields.	1	2	3	4	5

II.D. Factors Influencing the Decision to Take More Mathematics

How important will each of the following factors be in deciding whether or not you take more mathematics courses in high school than are required? The answer choices are "Not Important at All," "Not Important," Undecided," "Important," and "Very Important." (67-73)

	NOT IMPT AT ALL	NOT IMPT	UNDEC	IMPT	VERY IMPT
1. What my mother thinks.	1	2	3	4	5
2. What my father thinks.	1	2	3	4	5
3. What my teachers think.	1	2	3	4	5
4. How good or bad I am in mathematics.	1	2	3	4	5
5. How useful I think mathematics will be in getting into college.	1	2	3	4	5
6. Whether my friends take mathematics.	1	2	3	4	5
7. Whether my classmates approve of people who take a lot of mathematics.	1	2	3	4	5

III.A. Taking More Mathematics (Intended Participation)

1. How many years do you think you will take mathematics courses while you are in high school (grades 9, 10, 11, 12)? (75)

   1 None
   2 1 year
   3 2 years
   4 3 years
   5 4 years

2. How many years do you think you will take science courses while you are in high school (grades 9, 10, 11, 12)? (76)

   1 None
   2 1 year
   3 2 years
   4 3 years
   5 4 years

III.B. Family Status

1. With which adult or adults do you live? (77)

   1 Just my father
   2 Just my mother
   3 Both my parents (or guardians)
   4 Other
   5 My father and my step-mother
   6 My mother and step-father

2. If you live with only one parent, do you see your OTHER parent often? (78)

   1 Yes
   2 No
   3 I live with both parents (or guardians)

III.C. Parents Education

1. Which of the following best describes the highest level of education your father completed? (80)

   1 Completed 0 to 6 years of school
   2 Completed 7 to 9 years of school
   3 Completed 10 to 11 years of school
   4 Graduated from high school
   5 Attended a trade, vocational or technical school after high school
   6 Completed 1 to 3 years of college
   7 Graduated from a 4 year college or university
   8 Attended a graduate or professional school after college
   9 I don't know

2. Which of the following best describes the highest level of education you mother completed? (82)

   1 Completed 0 to 6 years of school
   2 Completed 7 to 9 years of school
   3 Completed 10 to 11 years of school
   4 Graduated from high school
   5 Attended a trade, vocational or technical school after high school
   6 Completed 1 to 3 years of college
   7 Graduated from a 4 year college or university
   8 Attended a graduate or professional school after college
   9 I don't know

III.D. Parents Occupation

2. In which group of careers does you father's occupation belong? You may not find your mother's exact career listed, but mark the one group in which you think it would fall. (79)

1 ARTISTS AND ENTERTAINERS--such as a writer, journalist, artist, musician, actor/actress, designer, professional athlete, etc.

2 CLERICAL, TECHNICAL AND SERVICE PERSONNEL--such as a bank teller, sales clerk, office worker, dental or medical technician, draftsman, computer programmer, policeman/woman, fireman, postal worker, nurse, etc.

3 EXECUTIVES--such as the president or vice president of a large company, government official or district manager, etc.

4 HOMEMAKER

5 MANAGEMENT AND MARKETING PERSONNEL--such as a store manager, insurance agent, owner of a small business, restaurant owner, real estate agent, sales representative, military officer, contractor, airline pilot, etc.

6 PROFESSIONALS--such as a doctor, lawyer, librarian, teacher, social worker, accountant, architect, physicist, minister, veterinarian, forester, etc.

7 SEMI-SKILLED WORKERS--such as a factory machine operator, keypunch operator, truck driver, factory worker, security guard, farm worker, waiter/waitress, cab or bus driver, laborer, gas station attendant, etc.

8 SKILLED WORKERS--such as a carpenter, plumber, mechanic, enlisted military person, farmer, tool and die worker, butcher, flight attendant, etc.

9 I don't know

2. In which group of careers does you mother's occupation belong? You may not find your mother's exact career listed, but mark the one group in which you think it would fall. (81)

1 ARTISTS AND ENTERTAINERS--such as a writer, journalist, artist, musician, actor/actress, designer, professional athlete, etc.

2 CLERICAL, TECHNICAL AND SERVICE PERSONNEL--such as a bank teller, sales clerk, office worker, dental or medical technician, draftsman, computer programmer, policeman/woman, fireman, postal worker, nurse, etc.

3 EXECUTIVES--such as the president or vice president of a large company, government official or district manager, etc.

4 HOMEMAKER

5 MANAGEMENT AND MARKETING PERSONNEL--such as a store manager, insurance agent, owner of a small business, restaurant owner, real estate agent, sales representative, military officer, contractor, airline pilot, etc.

6 PROFESSIONALS--such as a doctor, lawyer, librarian, teacher, social worker, accountant, architect, physicist, minister, veterinarian, forester, etc.

7 SEMI-SKILLED WORKERS--such as a factory machine operator, keypunch operator, truck driver, factory worker, security guard, farm worker, waiter/waitress, cab or bus driver, laborer, gas station attendant, etc.

8 SKILLED WORKERS--such as a carpenter, plumber, mechanic, enlisted military person, farmer, tool and die worker, butcher, flight attendant, etc.

9 I don't know

III.E. Mathematics Participation (Course-Taking)

When answering questions 83-89, if you are presently enrolled in a course that it names, answer "yes" even though you have not completed that course. Mark a one (1) for a yes response and a two (2) for a no response. (High school means grades 9-12.) (83-89)

		YES	NO
		1	2
1.	I completed a course in high school General Mathematics.	1	2
2.	I completed a course in high school Accounting or Business Mathematics.	1	2
3.	I completed a course in high school ConsumerMathematics.	1	2
4.	I completed a course in Algebra I in either grade 8, 9, or 10.	1	2
5.	I completed a course in high school Geometry.	1	2
6.	I completed a course in high school Algebra II.	1	2
7.	I took Algebra I while I was in the eighth grade.	1	2

When answering questions 90-99, please mark a one (1) for a yes response, two (2) for a no response, three (3) if you have already comleted the course in grades 9-12, and four (4) if you are presently enrolled in the course. (90-99)

		YES	NO	ALREADY COMPLETED	PRESENTLY ENROLLED
1.	I plan to complete a course in high school General Mathematics.	1	2	3	4
2.	I plan to complete a course in high school Accounting or Business mathematics.	1	2	3	4
3.	I plan to complete a course in high school Consumer Mathematics.	1	2	3	4
4.	I plan to complete a course in Algebra I.	1	2	3	4
5.	I plan to complete a course in high school Geometry.	1	2	3	4
6.	I plan to complete a course in high school Algebra II.	1	2	3	4
7.	I plan to complete a course in high school Trigonometry or a course in which Trigonometry is a major part.	1	2	3	4

		YES	NO	ALREADY COMPLETED	PRESENTLY ENROLLED
8.	I plan to complete a course in high school Computer Programming.	1	2	3	4
9.	I plan to complete a course in high school Pre-Calculus (e.g., advanced or senior mathematics, analytical geometry, elementry functions, advanced or college algebra, mathematics analysis.)	1	2	3	4
10.	I plan to complete a course in high school Calculus.	1	2	3	4

III.F. Socioeconomic Status (SES)

Please mark one (1) for a yes response and two (2) for a no response to the following set of questions. (100-109)

Do you have the following items in your home?		YES	NO
1.	A special place to study	1	2
2.	Daily newspaper	1	2
3.	Dictionary	1	2
4.	Encyclopedias	1	2
5.	Magazines	1	2
6.	Record Player	1	2
7.	Tape recorder or cassette player	1	2
8.	Color television	1	2
9.	Electric dishwasher	1	2
10.	Two or more cars or trucks that run	1	2

III.G. Grades in Mathematics

1. Which one of the following best describes the grades you have gotten in mathematics? (110)

   1 Excellent or A or (90% - 100%)
   2 Good or B or (80% - 89%)
   3 Average or C or (70% - 79%)
   4 Fair or D or (60% - 69%)
   5 Poor or Failing or F or (Below 60%)

III.H. Type of School Program

1. How would you classify the primary emphasis of your high school courses? (111)

   1 General
   2 Vocational, technical or trade
   3 College preparatory
   4 I am not yet in high school

2. Some people plan to take the high school college preparatory courses in math, some do not. Do you plan to take the high school college preparatory classes in mathematics? (112)

   1 Yes, I plan to.
   2 No, I do not plan to.

3. Please explain in detail your answer to question 112. (113)

IV.A. Father as Role Model

	STR DSAGR	DSAGR	UNDEC	AGR	STR AGR
1. My father likes mathematics. (114)	1	2	3	4	5
2. My father is good in mathematics. (115)	1	2	3	4	5

3. How often does your father use mathematics? (128)

   1 Often
   2 Sometimes
   3 Rarely
   4 Never

4. Who uses more mathematics in your home? (130)

   1 My mother
   2 My father
   3 Both my mother and father about the same

IV.B. Mother as Role Model

	STR DSAGR	DSAGR	UNDEC	AGR	STR AGR
1. My mother likes mathematics. (116)	1	2	3	4	5
2. My mother is good in mathematics. (117)	1	2	3	4	5

3. How often does your mother use mathematics? (129)

   1 Often
   2 Sometimes
   3 Rarely
   4 Never

IV.C. Father's Encouragement in Mathematics

	STR DSAGR	DSAGR	UNDEC	AGR	STR AGR
1. My father thinks advanced mathematics is a waste of time for me. (118)	1	2	3	4	5
2. My father has encouraged me to take all the mathematics I can. (119)	1	2	3	4	5
3. My father thinks mathematics is important to my future. (120)	1	2	3	4	5
4. My father does not feel that mathematics is important to my career. (121)	1	2	3	4	5

IV.D. Mother's Encouragement in Mathematics

	STR DSAGR	DSAGR	UNDEC	AGR	STR AGR
1. My mother thinks advanced mathematics is a waste of time for me. (122)	1	2	3	4	5
2. My mother has encouraged me to take all the mathematics I can. (123)	1	2	3	4	5
3. My mother thinks mathematics is important to my future. (124)	1	2	3	4	5
4. My mother does not feel that mathematics is important to my career. (125)	1	2	3	4	5

IV.E. Parent's Stereotyping of Mathematics

	STR DSAGR	DSAGR	UNDEC	AGR	STR AGR
1. My father thinks mathematics is more for Anglos than for Mexican Americans. (126)	1	2	3	4	5
2. My mother thinks mathematics is more for Anglos than for Mexican Americans. (127)	1	2	3	4	5

IV.F. Parents Helping with Homework

1. Who has helped you more with mathematics homework? (131)

   1 My father
   2 My mother
   3 My father and mother about equally
   4 Neither of my parents has helped me

IV.G. Parents' Educational Expectations for Offspring

1. What is the highest level of education your father expects you to complete? (132)

   1 Quit school
   2 High school
   3 Vocational, trade or technical school
   4 Two-year college
   5 Four-year college or university
   6 Graduate or professional school after college
   7 I don't know

2. What is the highest level of education your mother expects you to complete?

   1 Quit school
   2 High school
   3 Vocational, trade or technical school
   4 Two-year college
   5 Four-year college or university
   6 Graduate or professional school after college
   7 I don't know

IV.H. Sibling Role Models

1. Do you have an older brother who is good in mathematics? (134)

   1 I have an older brother who IS good in mathematics.
   2 I have an older brother who is NOT good in mathematics.
   3 I do not have an older brother.

2. Do you have an older sister who is good in mathematics?

   1 I have an older sister who IS good in mathematics.
   2 I have an older sister who is NOT good in mathematics.
   3 I do not have an older sister.

V.A. Peer Influence

		STR DSAGR	DSAGR	UNDEC	AGR	STR AGR
1.	My friends think mathematics is an important subject. (136)	1	2	3	4	5
2.	There are times when I feel I should play "dumb" in mathematics. (137)	1	2	3	4	5
3.	My friends would still like me if I were a really good mathematics student. (138)	1	2	3	4	5
4.	My friends look down on people who get good grades in mathematics. (139)	1	2	3	4	5
5.	I would like my friends to think I am smart in mathematics. (140)	1	2	3	4	5
6.	If I got good grades in mathematics, I would try to hide it. (141)	1	2	3	4	5

V.B. Peer Stereotyping of Mathematics

	STR DSAGR	DSAGR	UNDEC	AGR	STR AGR
1. The boys among my friends think mathematics is more for Anglos than for Mexican Americans. (142)	1	2	3	4	5
2. The girls among my friends think mathematics is more for Anglos than for Mexican Americans. (143)	1	2	3	4	5

V.C. Teacher Encouragement in Mathematics

	STR DSAGR	DSAGR	UNDEC	AGR	STR AGR
1. My mathematics teachers have discouraged me from taking more mathematics. (144)	1	2	3	4	5
2. Mathematics teachers have made me feel that I have the ability to go on in mathematics. (145)	1	2	3	4	5
3. My mathematics teachers think advanced mathematics is a waste of time for me. (146)	1	2	3	4	5
4. My mathematics teachers have encouraged my to take all the mathematics I can. (147)	1	2	3	4	5

V.D. Teacher Stereotyping of Mathematics

	STR DSAGR	DSAGR	UNDEC	AGR	STR AGR
1. Mathematics teachers think mathematics is more for Anglos than for Mexican Americans. (148)	1	2	3	4	5

V.E. Teacher Differential Treatment

	STR DSAGR	DSAGR	UNDEC	AGR	STR AGR
1. Mathematics teachers treat the Mexican Americans the same as Anglos in mathematics classes. (149)	1	2	3	4	5
2. Mathematics teachers expect Mexican Americans to do as well as Anglos in mathematics. (151)	1	2	3	4	5
3. Mathematics teachers usually call on Mexican Americans in class as much as Anglos. (151)	1	2	3	4	5
4. Mathematics teachers expect Anglos to do better in mathematics than Mexican Americans. (152)	1	2	3	4	5
5. Mathematics teachers usually encourage Anglos more than Mexican Americans to do well in mathematics. (153)	1	2	3	4	5
6. Mathematics teachers usually call on Anglos more than Mexican Americans. (154)	1	2	3	4	5

V.F. Counselor Encouragement to Take More Mathematics

1. Which one of the following statements best describes your experience with a school counselor? The counselor

   1 strongly encouraged me to take more mathematics than was required to graduate.
   2 encouraged me to take more mathematics than was required to graduate.
   3 did not care if I took more mathematics than was required to graduate.
   4 discouraged me from taking more mathematics than was required to graduate.
   5 strongly discouraged me from taking more mathematics than was required to graduate.
   6 has never counseled me about mathematics.
   7 My school does not have a counselor.

VI.A. Locus of Control

1. I am often blamed for things that just aren't my fault. (156)

2. I feel that most of the time it doesn't pay to try hard because things never turn our right anyway. (157)

3. I feel that most of the time parents listen to what their children have to say. (158)

4. I feel that one of the best ways to handle most problems is just not to think about them. (159)

5. Most of the time I feel that I can change what might happen tomorrow by what I do today. (160)

6. I believe that when bad things are going to happen they just are going to happen no matter what I try to do to stop them. (161)

7. I usually feel that it's almost useless to try in school because most other children are just plain smarter than I am. (162)

8. I am the kind of person who believes that planning ahead makes things turn out better. (163)

VI.B. Language Background

In this part of the survey, we are interested in the various languages students speak. Some people speak one language, others speak more than one language. Please answer each question as honestly as possible.

1. Think back to the earliest time in your life, which language were you first taught to speak? (164)

   1 Mainly Spanish
   2 Mainly English
   3 Equally Spanish and English
   4 Other

2. Which language did you speak to your parents <u>before</u> you started school? (165)

   1 Mainly Spanish
   2 Mainly English
   3 Equally Spanish and English
   4 Other

3. Which language did you speak to your grandparents before you started school? (166)

1 Mainly Spanish
2 Mainly English
3 Equally Spanish and English
4 Other

4. Which language did you speak to your brothers and sisters before you started school? (167)

1 Mainly Spanish
2 Mainly English
3 Equally Spanish and English
4 Other

5. Which language did you speak to your two best friends before you started school? (168)

1 Mainly Spanish
2 Mainly English
3 Equally Spanish and English
4 Other

6. Now which language do you speak to your parents? (169)

1 Mainly Spanish
2 Mainly English
3 Equally Spanish and English
4 Other

7. Now which language do you speak to your grandparents? (170)

1 Mainly Spanish
2 Mainly English
3 Equally Spanish and English
4 Other

8. Now which language do you speak to your brothers and sisters? (171)

1 Mainly Spanish
2 Mainly English
3 Equally Spanish and English
4 Other

9. Now which language do you speak to your two best friends? (172)

1 Mainly Spanish
2 Mainly English
3 Equally Spanish and English
4 Other

1. Some people speak with Spanish accents and some do not. Do you feel you speak English with a Spanish accent? (188)

   1 Yes, a heavy accent
   2 Yes, a moderate accent
   3 Yes, a slight accent
   4 No, none at all

2. Some people feel that speaking with a Spanich accent affects their grades. Other people feel that accents have no effect at all. Choose the response that best describes how speaking with a Spanish accent affects your grades.

   1 Affects my grades very negatively
   2 Affects my grades negatively
   3 Affects my grades positively
   4 Affects my grades very positively
   5 Does not affect my grades at all
   6 I do not have an accent

Some people have more opportunities to use Spanish than others. Complete each statement with the response that best describes your experience with each activity. (191-193)

	AT LST ONCE/MO	AT LST ONCE/WK	AT LST ONCE/MO	SELDOM	NEVER
1. I read newspapers, books, or magazines written in Spanish...	1	2	3	4	5
2. I watch a Spanish television station...	1	2	3	4	5
3. I listen to a Spanish radio station...	1	2	3	4	5

VI.C. Alienation

In this part of our survey, we want to know how you feel about some other problems facing people in our country today. Each item consists of a pair of statements. Please select the one statement of each pair (one only one) which you more strongly believe to be true. There are no right or wrong answers. Be sure to make a choice between each pair of statements. (173-177)

1. Many times I feel that I have little influence over the things that happen to me.

   I do not believe that chance and luck are very important in my life.

2. Becoming a success is a matter of hard work; luck has little or nothing to do with it.

   Getting a good job depends mainly on being in the right place at the right time.

3. When I make plans, I am fairly sure that I can make them work.

   It is not wise to plan too far ahead because most things turn out to be a matter of good or bad fortune anyhow.

4. What people call "bad luck" usually results from the mistakes they make.

   Sometimes I feel that I don't have enough control over the direction my life is taking.

5. What happens to me is my own doing.

   Most of the unhappy things in my life have been due to bad luck.

VI.D Value Orientation

Three young people were talking about what they themselves would have one day as compared with their parents. They each said different things.

1 The first said: I expect I will be better off in the future than my family if I work hard and plan right. Things in this country usually get better for people who really try.

2 The second said: I don't know whether I will be better off, the same, or worse off than my family. Things always go up and down even if people do work hard. So one can never really tell how things will be.

3 The third said: I expect to be about the same as my family. The best way is to work hard and plan ways to keep things as they have been in the past.

1. Which of these people do you think had the best idea? (178)

2. Which of the other two persons had the better idea? (179)

3. Which of these three people would most other students your age think had the best idea? (180)

Three men from different areas were talking about the things that control the weather and other conditions. Here is what they each said:

1 One man said: We have never controlled the rain, wind and other natural conditions and probably never will. There have always been good and bad years. That is the way it is, and if you are wise you will take it as it comes and do the best you can.

2 The second man said: We believe that it is our job to find ways to overcome weather and other conditions just as we have overcome so many things. We believe that one day we will succeed in doing this and may even overcome drought and floods.

3 The third man said: We help conditions and keep things going by working to keep in close touch with all the forces which make the rain, the snow, and other conditions. It is when we do the right things--live in the proper way--and keep all that we have--the land, the stock, and the water--in good condition, that all goes along well.

1. Which one of these men do you think had the best idea? (181)

2. Which of the other two men do you think had the better idea? (182)

3. Which of the three men would most other students your age think had the best idea? (183)

VI.E. Acculturation

1. Are one or both of your parents/guardians of Spanish descent (Mexican American, Chicano, Hispanic)? (184)

   1 Yes, my mother
   2 Yes, my father
   3 Yes, both my mother and my father
   4 Neither of my parents are of Spanish decent

2. Some Americans would also describe themselves as being a member of an ethnic group. Circle the way you would identify yourself. (185)

   1 Mexican American ethnic group
   2 Chicano ethnic group
   3 Hispanic ethnic group
   4 Other Spanish decent
   5 None of the above

3. Some members of American ethnic groups feel they have received full and equal acceptance into the larger American society, while others do not feel this acceptance. As a member of an ethnic group, do you feel you have: (186)

   1 Complete acceptance into American society
   2 Almost complete acceptance into American society
   3 Partial acceptance into American society
   4 Partial rejection from American society
   5 Almost complete rejection from American society
   6 Complete rejection from American society

4. Some Americans celebrate various ethnic or cultural festivals and holidays (St. Patrick's Day, 16th of September, Yom Kippur). Other Americans do not celebrate any ethnic holidays. Do you celebrate your ethnic holidays each year? (187)

   1 Yes, most holidays
   2 Yes, some holidays
   3 Yes, few holidays
   4 No, none at all

5. Some Americans believe that their ethnic or cultural group generally is better than other cultural or ethnic groups. On the other hand, other people believe there really are no differences between ethnic or cultural groups. Do you believe your ethnic group is: (190)

   1 Superior to other ethnic or cultural groups.
   2 Somewhat superior to other ethnic or cultural groups.
   3 Somewhat inferior to other ethnic or cultural groups.
   4 Inferior to other ethnic or cultural groups.
   5 Neither inferior nor superior to other ethnic or cultural groups.

Not counting your own relatives, indicate below the ethnic identity of your two closest friends. (194-195)

6. Best friend

   1 Ethnic group same as mine
   2 Ethnic group different than mine
   3 Do not know ethnic group

7. Second closest friend

   1 Ethnic group same as mine
   2 Ethnic group different than mine
   3 Do not know ethnic group

8. In thinking about dating, would you prefer to date someone who is: (196)

   1 the same ethnic identity as myself
   2 a different ethnic identity than myself
   3 Ethnic identity is not a factor in deciding who I would like to date.

9. Some individuals in America have retained the practice of eating the same kind of food their ancestors ate. Do you eat this same kind of food on a regular basis? (197)

   1 Yes, regularly
   2 Yes, occasionally
   3 Yes, infrequently
   4 No, not at all

10. Regarding religious beliefs and practices, what was the religion of your mother's parents? (198)

1 Roman Catholic
2 Jewish
3 Protestant. What denomination?
4 Latter Day Saints
5 Other
6 Do not know

11. Regarding religious beliefs and practices, what was the religion of your father's parents? (199)

1 Roman Catholic
2 Jewish
3 Protestant. What denomination?
4 Latter Day Saints
5 Other
6 Do not know

12. Do you now belong to the same religion as your mother's parents? (200)

1 Yes
2 No
3 Do not know the religion of my mother's parents

13. Do you now belong to the same religion as your father's parents? (201)

1 Yes
2 No
3 Do not know the religion of my father's parents

14. Are you active in the same religion as your mother's parents? (202)

1 Very active
2 Active
3 Moderately active
4 Not active
5 Do not know the religion of my mother's parents

15. Are you active in the same religion as your father's parents? (203)

1 Very active
2 Active
3 Moderately active
4 Not active
5 Do not know the religion of my father's parents

16. Does you father speak Spanish at home? (204)

1 Yes, 100% of the time
2 Yes, 75% of the time
3 Yes, 50% of the time
4 Yes, 25% of the time
5 Yes, less than 25% of the time
6 No, not at all

17. Does you mother speak Spanish at home? (205)

1 Yes, 100% of the time
2 Yes, 75% of the time
3 Yes, 50% of the time
4 Yes, 25% of the time
5 Yes, less than 25% of the time
6 No, not at all

18. Do you speak Spanish? (206)

1 Yes, very fluently
2 Yes, fluently
3 Yes, poorly
4 No, not at all

19. Do you read Spanish? (207)

1 Yes, very fluently
2 Yes, fluently
3 Yes, poorly
4 No, not at all

20. Do you write Spanish? (208)

1 Yes, very fluently
2 Yes, fluently
3 Yes, poorly
4 No, not at all

21. Have you visited the country of origin of either your mother's or father's parents? (209)

1 Yes
2 No
3 My mother's and father's parents were born in the United States.

Could you indicate below the country where both your father's and mother's parents were born? (210-211)

		COUNTRY
1.	Father's:	
	Mother	_____
	Father	_____
2.	Mother's:	
	Mother	_____
	Father	_____

APPENDIX C

Source Documentation

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APPENDIX D

Supplementary Tables

APPENDIX D

Key to Table Labels

Label	Name
Score	Cognitive Style
ALLEN	Alienation
SIN 1	Overall Self Attitudes Toward Math
SIN 3	Parents as Educational Role Models
LCont	Locus of Control
Factor 1	Opinions of Authority Figures
Factor 2	Attitudes Twoard Stereotypes
Factor 3	Amount of Math, Sci. and Ed. Needed
Factor 4	Attitudes Toward Sexual Stereotypes
Factor 5	Attitudes Toward Money and Status
Q2	Occupational Aspirations
Q23	Educational Expectation
Q75	Number of Years of Math Planned
Q80	Father's Educational Level
Q110	Math Grades
Q112	College Prep Course in Math
Q185	Ethnicity
Q186	Acculturation
IN 1	Importance of Math
IN 3	Confidence in Math
IN 5	Enjoyment of Math
IN 6	Math as Anglo Domain
IN 11	Peer Influence

Label	Name
IN 12	Teacher's Influence
IN 13	Teacher Differential Treatment
IN 14	Spanish Language Use
IN 15	Father as Role Model
IN 16	Sibling as Role Model
IN 17	Math Courses Completed
IN 18	Math Courses Planned
IN 19	Spanish Fluency
IN 20	Math Anxiety
IN 21	School Anxiety
IN 22	English Anxiety
IN 23	Science Anxiety
IN 24	Parents Educational Expectations
IN 25	Mother as Role Model

TABLE 1

* * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * *

SCORE
BY GRADE
Q185
SEX

* * * * * * * * * \

TABLE 2

* * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * *

ALLEN
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	0.447	4	0.112	2.809	0.025
GRADE	0.279	2	0.139	3.502	0.031
Q185	0.131	1	0.131	3.284	0.070
SEX	0.049	1	0.049	1.234	0.267
2-WAY INTERACTIONS	0.195	5	0.039	0.982	0.428
GRADE Q185	0.021	2	0.011	0.269	0.765
GRADE SEX	0.124	2	0.062	1.554	0.212
Q185 SEX	0.040	1	0.040	0.994	0.319
3-WAY INTERACTIONS	0.032	2	0.016	0.404	0.668
GRADE Q185 SEX	0.032	2	0.016	0.404	0.668

TABLE 3

* * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * *

Q80
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF. OF F
MAIN EFFECTS	147.347	4	36.837	7.712	0.000
GRADE	19.225	2	9.613	2.013	0.135
Q185	120.206	1	120.206	25.167	0.000
SEX	4.779	1	4.779	1.001	0.318
2-WAY INTERACTIONS	27.228	5	5.446	1.140	0.338
GRADE Q185	10.268	2	5.134	1.075	0.342
GRADE SEX	16.416	2	8.208	1.719	0.180
Q185 SEX	0.003	1	0.003	0.001	0.979
3-WAY INTERACTIONS	10.850	2	5.425	1.136	0.322
GRADE Q185 SEX	10.849	2	5.425	1.136	0.322

TABLE 4

* * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * *

IN12
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	1.001	4	0.250	0.517	0.723
GRADE	0.516	2	0.258	0.533	0.587
Q185	0.105	1	0.105	0.217	0.642
SEX	0.312	1	0.312	0.646	0.422
2-WAY INTERACTIONS	6.479	5	1.296	2.680	0.021
GRADE Q185	2.319	2	1.160	2.398	0.092
GRADE SEX	3.600	2	1.800	3.723	0.025
Q185 SEX	0.169	1	0.169	0.349	0.555
3-WAY INTERACTIONS	1.044	2	0.522	1.080	0.340
GRADE Q185 SEX	1.044	2	0.522	1.080	0.340

TABLE 5

* * * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * * *

LCONT
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	1.227	4	0.307	6.132	0.000
GRADE	0.900	2	0.450	8.995	0.000
Q185	0.116	1	0.116	2.327	0.128
SEX	0.259	1	0.259	5.169	0.023
2-WAY INTERACTIONS	0.262	5	0.052	1.046	0.390
GRADE Q185	0.058	2	0.029	0.582	0.559
GRADE SEX	0.099	2	0.049	0.987	0.373
Q185 SEX	0.104	1	0.104	2.074	0.150
3-WAY INTERACTIONS	0.069	2	0.034	0.688	0.503
GRADE Q185 SEX	0.069	2	0.034	0.688	0.503

TABLE 6

* * * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * * *

Q187
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	20.369	4	5.092	4.330	0.002
GRADE	18.772	2	9.386	7.982	0.000
Q185	0.452	1	0.452	0.384	0.536
SEX	1.171	1	1.171	0.996	0.319
2-WAY INTERACTIONS	2.447	5	0.489	0.416	0.837
GRADE Q185	2.310	2	1.155	0.982	0.376
GRADE SEX	0.061	2	0.030	0.026	0.975
Q185 SEX	0.000	1	0.000	0.000	0.998
3-WAY INTERACTIONS	5.429	1	5.429	4.617	0.032
GRADE Q185 SEX	5.429	1	5.429	4.617	0.032

TABLE 7

* * * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * * *

FAC1
BY GRADE
Q185
SEX

* * * * * * * * * * \

TABLE 8

* * * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * * *

FAC2
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	5.787	4	1.447	1.662	0.157
GRADE	2.419	2	1.205	1.384	0.251
Q185	3.397	1	3.397	3.902	0.049
SEX	0.004	1	0.004	0.005	0.944
2-WAY INTERACTIONS	4.723	5	0.945	1.085	0.367
GRADE Q185	0.641	2	0.320	0.368	0.692
GRADE SEX	4.015	2	2.008	2.306	0.101
Q185 SEX	0.019	1	0.019	0.022	0.883
3-WAY INTERACTIONS	2.677	2	1.338	1.537	0.216
GRADE Q185 SEX	2.677	2	1.338	1.537	0.216

TABLE 9

* * * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * * *

FAC3
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	15.022	4	3.755	4.858	0.001
GRADE	0.014	2	0.007	0.009	0.991
Q185	10.350	1	10.350	13.390	0.000
SEX	4.184	1	4.184	5.413	0.020
2-WAY INTERACTIONS	1.864	5	0.373	0.482	0.790
GRADE Q185	0.966	2	0.483	0.625	0.536
GRADE SEX	0.770	2	0.385	0.498	0.608
Q185 SEX	0.148	1	0.148	0.191	0.662
3-WAY INTERACTIONS	1.832	2	0.916	1.185	0.306
GRADE Q185 SEX	1.832	2	0.916	1.185	0.306

TABLE 10

* * * * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * * * *

FAC4
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	21.222	4	5.306	7.585	0.000
GRADE	2.377	2	1.189	1.700	0.184
Q185	7.759	1	7.759	11.093	0.001
SEX	11.318	1	11.318	16.181	0.000
2-WAY INTERACTIONS	2.942	5	0.588	0.841	0.521
GRADE Q185	2.573	2	1.286	1.839	0.160
GRADE SEX	0.262	2	0.131	0.187	0.829
Q185 SEX	0.074	1	0.074	0.106	0.745
3-WAY INTERACTIONS	1.202	2	0.601	0.859	0.424
GRADE Q185 SEX	1.202	2	0.601	0.859	0.424

TABLE 11

* * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * *

FAC5
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	8.355	4	2.089	4.112	0.003
GRADE	2.122	2	1.061	2.089	0.125
Q185	1.122	1	1.122	2.208	0.138
SEX	5.171	1	5.171	10.179	0.001
2-WAY INTERACTIONS	3.794	5	0.759	1.494	0.190
GRADE Q185	0.760	2	0.380	0.748	0.474
GRADE SEX	2.200	2	1.100	2.165	0.116
Q185 SEX	0.745	1	0.745	1.466	0.226
3-WAY INTERACTIONS	2.701	2	1.351	2.659	0.071
GRADE Q185 SEX	2.701	2	1.351	2.659	0.071

TABLE 12

* * * * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * * * *

Q2
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	1.202	4	0.301	1.903	0.108
GRADE	1.146	2	0.573	3.629	0.027
Q185	0.014	1	0.014	0.090	0.765
SEX	0.024	1	0.024	0.151	0.698
2-WAY INTERACTIONS	0.305	5	0.061	0.387	0.858
GRADE Q185	0.072	2	0.036	0.226	0.797
GRADE SEX	0.174	2	0.087	0.552	0.576
Q185 SEX	0.046	1	0.046	0.294	0.588
3-WAY INTERACTIONS	0.013	2	0.006	0.041	0.960
GRADE Q185 SEX	0.013	2	0.006	0.041	0.960

TABLE 13

* * * * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * * * *

IN1
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	2.514	4	0.628	1.707	0.147
GRADE	0.769	2	0.384	1.044	0.353
Q185	0.755	1	0.755	2.051	0.153
SEX	1.044	1	1.044	2.837	0.093
2-WAY INTERACTIONS	0.962	5	0.192	0.522	0.759
GRADE Q185	0.453	2	0.226	0.615	0.541
GRADE SEX	0.499	2	0.249	0.678	0.508
Q185 SEX	0.015	1	0.015	0.042	0.838
3-WAY INTERACTIONS	0.859	2	0.429	1.166	0.312
GRADE Q185 SEX	0.859	2	0.429	1.166	0.312

TABLE 14

* * * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * * *

IN11
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	0.953	4	0.238	1.740	0.139
GRADE	0.147	2	0.074	0.538	0.584
Q185	0.183	1	0.183	1.333	0.249
SEX	0.628	1	0.628	4.582	0.033
2-WAY INTERACTIONS	0.185	5	0.037	0.270	0.929
GRADE Q185	0.049	2	0.024	0.178	0.837
GRADE SEX	0.001	2	0.001	0.005	0.995
Q185 SEX	0.138	1	0.138	1.005	0.316
3-WAY INTERACTIONS	0.194	2	0.097	0.708	0.493
GRADE Q185 SEX	0.194	2	0.097	0.708	0.493

TABLE 15

* * * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * * *

IN13
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	3.283	4	0.821	4.340	0.002
GRADE	2.580	2	1.290	6.821	0.001
Q185	0.465	1	0.465	2.459	0.117
SEX	0.183	1	0.183	0.966	0.326
2-WAY INTERACTIONS	1.356	5	0.271	1.434	0.210
GRADE Q185	0.526	2	0.263	1.390	0.250
GRADE SEX	0.547	2	0.274	1.447	0.236
Q185 SEX	0.244	1	0.244	1.291	0.256
3-WAY INTERACTIONS	1.509	2	0.754	3.989	0.019
GRADE Q185 SEX	1.509	2	0.754	3.989	0.019

TABLE 16

* * * * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * * * *

IN14
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	1749.103	4	437.276	354.533	0.000
GRADE	1.081	2	0.541	0.438	0.645
Q185	1733.794	1	1733.794	1405.722	0.000
SEX	6.240	1	6.240	5.059	0.025
2-WAY INTERACTIONS	17.562	5	3.512	2.848	0.015
GRADE Q185	8.771	2	4.385	3.555	0.029
GRADE SEX	3.360	2	1.680	1.362	0.257
Q185 SEX	5.938	1	5.938	4.814	0.029
3-WAY INTERACTIONS	2.823	2	1.411	1.144	0.319
GRADE Q185 SEX	2.823	2	1.411	1.144	0.319

TABLE 17

* * * * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * * * *

IN15
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	6.153	4	1.538	2.550	0.038
GRADE	0.158	2	0.079	0.131	0.877
Q185	4.542	1	4.542	7.529	0.006
SEX	1.591	1	1.591	2.638	0.105
2-WAY INTERACTIONS	2.749	5	0.550	0.911	0.473
GRADE Q185	2.074	2	1.037	1.719	0.180
GRADE SEX	0.559	2	0.279	0.463	0.630
Q185 SEX	0.015	1	0.015	0.025	0.875
3-WAY INTERACTIONS	0.597	2	0.298	0.495	0.610
GRADE Q185 SEX	0.597	2	0.298	0.495	0.610

TABLE 18

* * * * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * * * *

IN16
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	3.550	4	0.887	3.031	0.017
GRADE	3.170	2	1.585	5.413	0.005
Q185	0.107	1	0.107	0.364	0.546
SEX	0.409	1	0.409	1.396	0.238
2-WAY INTERACTIONS	2.967	5	0.593	2.027	0.073
GRADE Q185	1.249	2	0.624	2.133	0.119
GRADE SEX	1.550	2	0.775	2.647	0.072
Q185 SEX	0.235	1	0.235	0.803	0.371
3-WAY INTERACTIONS	2.731	2	1.366	4.664	0.010
GRADE Q185 SEX	2.731	2	1.366	4.664	0.010

TABLE 19

* * * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * * *

IN3
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	6.366	4	1.592	4.351	0.002
GRADE	2.539	2	1.269	3.471	0.032
Q185	0.036	1	0.036	0.098	0.754
SEX	3.889	1	3.889	10.633	0.001
2-WAY INTERACTIONS	3.918	5	0.784	2.143	0.059
GRADE Q185	0.294	2	0.147	0.403	0.669
GRADE SEX	3.535	2	1.767	4.832	0.008
Q185 SEX	0.002	1	0.002	0.006	0.939
3-WAY INTERACTIONS	0.854	2	0.427	1.167	0.312
GRADE Q185 SEX	0.854	2	0.427	1.167	0.312

TABLE 20

* * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * *

IN25
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	2.152	4	0.538	1.280	0.276
GRADE	0.627	2	0.314	0.746	0.475
Q185	0.575	1	0.575	1.369	0.242
SEX	0.895	1	0.895	2.131	0.145
2-WAY INTERACTIONS	0.914	5	0.183	0.435	0.824
GRADE Q185	0.604	2	0.302	0.719	0.488
GRADE SEX	0.282	2	0.141	0.336	0.715
Q185 SEX	0.034	1	0.034	0.081	0.776
3-WAY INTERACTIONS	0.163	2	0.082	0.194	0.823
GRADE Q185 SEX	0.163	2	0.082	0.194	0.823

TABLE 21

* * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * *

IN17
BY GRADE
Q185
SEX

* * * * * * * * * \

TABLE 22

* * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * *

IN20
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	3.790	4	0.947	2.885	0.022
GRADE	1.365	2	0.683	2.078	0.126
Q185	0.040	1	0.040	0.122	0.727
SEX	2.408	1	2.408	7.331	0.007
2-WAY INTERACTIONS	3.725	5	0.745	2.268	0.046
GRADE Q185	0.157	2	0.078	0.239	0.788
GRADE SEX	3.505	2	1.752	5.336	0.005
Q185 SEX	0.015	1	0.015	0.045	0.832
3-WAY INTERACTIONS	0.311	2	0.156	0.474	0.623
GRADE Q185 SEX	0.311	2	0.156	0.474	0.623

TABLE 23

* * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * *

IN21
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	4.887	4	1.222	1.764	0.134
GRADE	4.088	2	2.044	2.950	0.053
Q185	0.119	1	0.119	0.172	0.678
SEX	0.949	1	0.949	1.370	0.242
2-WAY INTERACTIONS	8.198	5	1.640	2.367	0.038
GRADE Q185	2.961	2	1.481	2.137	0.119
GRADE SEX	4.450	2	2.225	3.212	0.041
Q185 SEX	0.752	1	0.752	1.085	0.298
3-WAY INTERACTIONS	1.690	2	0.845	1.220	0.296
GRADE Q185 SEX	1.690	2	0.845	1.220	0.296

TABLE 24

* * * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * * *

IN22
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	16.649	4	4.162	6.055	0.000
GRADE	1.322	2	0.661	0.962	0.383
Q185	2.304	1	2.304	3.352	0.068
SEX	13.115	1	13.115	19.077	0.000
2-WAY INTERACTIONS	4.263	5	0.853	1.240	0.289
GRADE Q185	0.280	2	0.140	0.204	0.816
GRADE SEX	1.435	2	0.717	1.044	0.353
Q185 SEX	2.615	1	2.615	3.804	0.052
3-WAY INTERACTIONS	0.088	2	0.044	0.064	0.938
GRADE Q185 SEX	0.088	2	0.044	0.064	0.938

TABLE 25

* * * * * * * * * * ANALYSIS OF VARIANCE * * * * * * * * * *

IN23
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	12.435	4	3.109	4.749	0.001
GRADE	0.030	2	0.015	0.023	0.977
Q185	5.790	1	5.790	8.845	0.003
SEX	6.988	1	6.988	10.674	0.001
2-WAY INTERACTIONS	2.709	5	0.542	0.828	0.530
GRADE Q185	1.571	2	0.785	1.200	0.302
GRADE SEX	1.091	2	0.545	0.833	0.435
Q185 SEX	0.005	1	0.005	0.008	0.928
3-WAY INTERACTIONS	0.852	2	0.426	0.651	0.522
GRADE Q185 SEX	0.852	2	0.426	0.651	0.522

TABLE 26

* * * * * * * * * * ANALYSIS OF VARIANCE * * * * * * * * * *

IN5
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	2.175	4	0.544	0.862	0.486
GRADE	0.169	2	0.084	0.134	0.875
Q185	1.366	1	1.366	2.166	0.142
SEX	0.535	1	0.535	0.849	0.357
2-WAY INTERACTIONS	8.008	5	1.602	2.539	0.027
GRADE Q185	2.045	2	1.023	1.622	0.198
GRADE SEX	4.077	2	2.039	3.232	0.040
Q185 SEX	1.979	1	1.979	3.138	0.077
3-WAY INTERACTIONS	0.116	2	0.058	0.092	0.912
GRADE Q185 SEX	0.116	2	0.058	0.092	0.912

TABLE 27

* * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * *

IN6
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	14.518	4	3.629	9.625	0.000
GRADE	1.107	2	0.554	1.468	0.231
Q185	9.279	1	9.279	24.610	0.000
SEX	4.560	1	4.560	12.094	0.001
2-WAY INTERACTIONS	1.900	5	0.380	1.008	0.412
GRADE Q185	0.669	2	0.335	0.888	0.412
GRADE SEX	0.470	2	0.235	0.623	0.537
Q185 SEX	0.679	1	0.679	1.802	0.180
3-WAY INTERACTIONS	1.255	2	0.628	1.665	0.190
GRADE Q185 SEX	1.255	2	0.628	1.665	0.190

TABLE 28

* * * * * * * * * * * A N A L Y S I S O F V A R I A N C E * * * * * * * * * * *

IN19
BY GRADE
Q185
SEX

* *

SOURCE OF VARIATION	SUM OF SQUARES	DF	MEAN SQUARE	F	SIGNIF OF F
MAIN EFFECTS	1001.854	4	250.464	363.739	0.000
GRADE	0.340	2	0.170	0.247	0.781
Q185	994.157	1	994.157	1443.779	0.000
SEX	2.550	1	2.550	3.703	0.055
2-WAY INTERACTIONS	3.730	5	0.746	1.083	0.368
GRADE Q185	0.534	2	0.267	0.388	0.679
GRADE SEX	1.499	2	0.749	1.088	0.337
Q185 SEX	1.757	1	1.757	2.551	0.111
3-WAY INTERACTIONS	1.021	2	0.510	0.741	0.477
GRADE Q185 SEX	1.021	2	0.510	0.741	0.477

APPENDIX E

Consultants

Consultants

Dr. Darrel Montero,
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Dr. Paul Wong,
Professor
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Survey Administrators

Ms. Sherryl Kim Cook

Mr. John Davids Kiefer

Mrs. Cynthia K. Ryan

Research Assistant

Ms. Mary May-Yuarn Liu

APPENDIX F

List of School Districts and Schools

Ajo Unified District

- Ajo High School

Tolleson Elementary District

- Tolleson Junior High

Tolleson Union High School District

- Tolleson Union High School

Amphitheater Unified District

- Amphitheater High School
- Lawrence W. Cross Junior High
- Canyon del Oro High School

Sunnyside Unified District

- Apollo Junior High
- Sunnyside Freshman Campus
- Sunnyside High School

Tucson Unified District

- Maxwell Junior High
- Chollo High School
- Catalina High School
- Palo Verde High School
- Sahuaro High School
- Santa Rita High School
- Tucson High School

Casa Grande Union High School District

- Casa Grande Union High School

Mingus Union High School District

- Mingus Union High School

Yuma Elementary District No. 1

- Gila Vista Junior High School
- Fourth Avenue Junior High

Yuma Union High School District

- Yuma High School
- Kofa High School

Sierra Vista School District

South Middle School
Buena High School

Willcox Unified District #13

Willcox High School

Flagstaff Unified District No. 1

East Flagstaff Junior High School
Coconino High School

Safford Unified District No. 1

Safford Junior High School
Safford High School

Agua Fria Union High School District

Agua Fria Union High School

Glendale Union High School District

Apollo High School
Moon Valley High School
Glendale High School

Mesa Unified District

Rhodes Junior High School
Mesa Junior High School
Mesa High School

Cartwright Elementary District

Frank Borman
Estrella Junior High

Phoenix Union High School District

Trevor Browne High School
Maryvale High School
South Mountain High School
Alhambra High School
Carl Hayden High School

Scottsdale Unified District

Coronado High School

APPENDIX G

Written Parent Questionnaire

NAME_____OCCUPATION_____BIRTHPLACE_____

RELATIONSHIP TO CHILD_____(Father, Mother, Stepfather, Stepmother, etc.)

YOUR EDUCATIONAL LEVEL_____YOUR MOTHER'S EDUCATIONAL LEVEL_____

YOUR FATHER'S EDUCATIONAL LEVEL_____YOUR ETHNICITY OR RACE_____RELIGION_____

SCHOOL CHILD ATTENDS_____GRADE IN SCHOOL_____SCHOOL DISTRICT_____

_____

PLEASE CONTINUE ANSWERS TO QUESTIONS ON EXTRA PAGES IF NECESSARY.

Your child has been identified as a high achiever in math. In your opinion, why does he/she perform well in mathematics?

In what ways have you been involved in your child's education?

Do you feel that taking math courses at the high school level is important for your child's future education and career?

Do you hope that you child will go to college? Why or why not?

Do you think that your child may have a career in a math or science-related field? Why or why not?

Do you feel that your race, ethnicity, or sex have kept you from getting the kind of education or career that you wanted? Why or who not?

Do you feel that race, ethnicity, or sex may prevent your child from reaching his/her educational or career goals? Why or who not?

APPENDIX H

Interview Form -- Parent

ATTITUDES TOWARD MATH

Are you "good" at solving problems in mathematics? Why do you think you are (or not)?

Do you enjoy solving math problems?

How did you feel about mathematics when you were in school? Why do you think you felt that way? Was math easy or difficult for you?

What was your favorite subject in school? Why?

Did you feel anxious when you took math tests?

Do you think that some people are naturally better at math than others (like males vs females or Mexican-Americans vs Anglos)? Why?

Do you feel that math is useful?

Do you think that your child is good at math? Why do you think this is so?

Why did you/didn't you go into a career in a math or science related field?

Do you think that math or science career is more appropriate for males than females? Why or why not?

Do you think that a career in math or science would be more demanding or difficult than other careers?

Why do you think that far fewer women and members of some minority groups go into math or science fields than other kinds of people?

Have you and your child discussed which courses he/she should be taking in high school?

Have you discussed which/how many math and science courses he/she should take?

Do you feel that studying math and/or science may be important to your child's future career?

Do you think that it will be important for your child to also study math in college?

Interview Form -- Parent

LANGUAGE, CULTURE, AND FAMILY

Tell me something about what life was like in your family when you were growing up? Probe for what parents were like, what they did, language spoken in the home, rural or urban, place grew up in, traditions and customs, how celebrated holidays, church activities and beliefs, parental aspirations and expectations for children, how many family members and where in birth order, chores, responsibilities, parents' attitudes toward education.

And how is life now in your family the same or different for your children?

Would you describe a typical evening with your family? Weekend? Probe for discussions, homework, games, etc.

Do you feel that it is important for your children to speak Spanish and to keep up some or many of the old traditions and customs? Why or why not?

Do you belong to any organizations in the community?

What are your hobbies or favorite activities? Do you like to read?

Do you feel that you have been discriminated against or denied opportunities in life because of your ethnicity or sex?

Do you feel that your children have been or may be discriminated against?

Do you feel that this could affect their educational achievement and careers?

Is it important to you to be involved in your child's education? How do you do this? Probe for help with homework, encouragement, rewards, punishments, how does parent react to good or bad grades?

What are your child's duties in the home?

What do you expect from your child in terms of behavior?

How would you describe yourself as a parent?

Tell me about your child when he/she was younger. Probe for preschool, early accomplishments in reading or math, early interests, parental coaching with letters or numbers, trips to library, reading, music.

Have any of your children had any serious behavior problems?

How would you describe your relationship with your child?

Interview Form -- Parent

CAREER ASPIRATIONS AND ATTITUDES

When you were a child what did you want to be when you grew up?

Tell me something about the work you do now and how you feel about it?

Do you hope that your child(ren) will go to college? Probe for sex difference, age and birth order difference, attitude about subject child.

Is there a career that you think would be a good one for your child?

Why did you pick this career instead of one in math or science or one that involves the use of mathematics?

What do you think could prevent your child from attaining his educational or career goals?

How will your childs education be financed?

INFLUENCE OF OTHERS

Was there anyone in your life who made you feel really interested in mathematics? Who encouraged you? Probe for parents, siblings, other relatives, friends, teachers, couselors.

Was there anyone who made you feel that you weren't very good at math/schoolwork? Explain how, when where?

What prevented you from attaining your educational or career goals?

What helped you to attain your educational or career goals?

What is the most important thing in your life?

Interview Form -- Child

ATTITUDES TOWARD MATH

Are you "good" at solving problems in mathematics? Why do you think you are (or not)?

Do you enjoy solving math problems?

How do you feel about mathematics as a subject? Why do you think you feel this way? Have you always felt this way?

Is math easy or difficult for you compared to other subjects?

What is your favorite subject in school? Why?

Do you feel anxious when you took math tests?

Do you feel more anxious when you take math tests than when you take other kinds of tests?

Do you think that some people are naturally better at math than others (like males vs females or Mexican-Americans vs Anglos)? Why?

Do you feel that math is useful?

Do you think that a math or science career is more appropriate for males than females? Why or why not?

Do you think that a career in math or science would be more demanding or difficult than other careers?

Why do you think that far fewer women and members of some minority groups go into math or science fields than other kinds of people?

Have you and your parents discussed which courses you should be taking in high school?

Have you discussed which/how many math and science courses you should take?

Do you feel that studying math and/or science may be important to your future career?

Do you think that it will be important for you to also study math in college?

Interview Form -- Child

LANGUAGE, CULTURE, AND FAMILY

Would you describe a typical day for you from morning to evening? Probe for time spent on homework, television watching, jobs, with friends, chores, hobbies, time with family, games, sports, community activities, and church activities.

Describe a typical weekend.

Is it important to you to speak Spanish or to learn to speak Spanish? Why or why not?

Is it important to you to keep up some of the old traditions and customs that are a part of your ethnic heritage? Why or why not?

What are your hobbies or favorite activities? Do you like to read?

Do you belong to any organizations or clubs in the community?

Do you feel that you have been discriminated against or denied opportunities to do things because of your ethnicity or sex?

Do you think that your parents feel that your schoolwork is important? How have they shown this or not? Probe for homework, rewards, punishments, etc.

Do you feel that your mother/father is interestered in helping you attain your educational goals? How has he/she shown this?

What is most important to you: (1) Pleasing your parents, (2) Learning as much as possible in school, (3) Being accepted & liked by other students in school.

What are your duties in the home?

What kinds of behavior do your parents expect from you?

Do you remember doing things with your mother and father when you were younger that might have influenced your interest in school like reading to you, taking you to the library, helping you with your numbers or letters, or using flashcards, etc.?

How would you describe your mother/father?

How would you describe your relationship with your mother/father?

Interview Form -- Child

CAREER ASPIRATIONS AND ATTITUDES

Do you hope to go to college? Why? How many years?

If you could pick any future career what would you want? Why?

What future career do you think you may actually have? Why?

Why did you pick this career instead of one in math or science or one that involves the use of mathematics?

What do you think your parents want you to be? Why?

How will you finance your college education? Probe for how much help subject thinks parents will give.

What do you think might prevent you from obtaining your educational goals?

INFLUENCE OF OTHERS

Has there been anyone in your life who made you feel really interested in mathematics -- who encouraged you? Probe for parents, siblings, other relatives, friends, teachers, tutors, counselors.

Has anyone talked to you about the importance of math to your future education or career? Probe for parents, teachers, counselor, etc.

Do you know anyone personally who has a career involving the use of mathematics?

Do you know anyone who has the kind of career you would like to have?

Have you had any negative feedback about being good in math or other subjects from anyone?

What are your friends like? What kinds of grades do they make? Have you talked to them about what courses to take, college, or career possibilities? How do they feel about math?

Has there been anyone in your life who made you feel that you weren't very good at math -- who discouraged you?

APPENDIX I

Contents of Indexes

Index Number	Name of Index	Contents (Questions Used)
1.	Locus of control	(156 + 157 + 159 + 161 + 162)/5
2.	Alienation	(164 + 165 + 166 + 167 + 168)/5
3.	Importance of mathematics	(31 + 32 + 33 + 34 + 35 + 36)/6
4.	Confidence in mathematics	(37 + 38 + 39 + 40 + 41 + 42)/6
5.	Enjoyment in mathematics	(59 + 60 + 61 + 62)/4
6.	Mathematics Axiety	(37 + 38 + ... + 48)/12
7.	School Anxiety	(49 + 50)/2
8.	English Anxiety	(51 + 52 + 53 + 54)/4
9.	Science Anxiety	(55 + 56 + 57 + 58)/4
10.	Overall Self-Attitude Towards Mathematics	Index (3 + 4 + 5 + 6)/4
11.	Mother as Educational Role Model	(116 + 117 + 122 + 123 + 124 + 125)/6
12.	Father as Educational Role Model	(114 + 115 + 118 + 119 + 120 + 120)/6
13.	Parents as Educational Role Model	Index (11 + 12)/2
14.	Parents' Educational Expectations	(132 + 133)/2
15.	Peers' Academic Influence	(136 + 137 + ... + 141)/6
16.	Teachers' Academic Influence	(144 + 145 + 146 + 147)/4
17.	Teachers' Differential Treatment	(149 + 150 + ... + 154)/6

Index Number	Name of Index	Contents (Questions Used)
18.	Sibling as Educational Role Model	(134 + 135)/2
19.	Mathematics Courses Completed	(83 + 84 + ... + 89)/7
20.	Mathematics Courses Planned	(90 + 91 + ... + 99)/10
21.	Spanish Use	(191 + 192 + 193)/3
22.	Spanish Fluency	(206 + 207 + 208)/3